Hardware Service Manual

Allen-Bradley

PowerFlex Digital DC Drive - Frame A

1.5…75 Hp (1.2…56 kW)

Allen-Bradley • Rockwell Software

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Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation® sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

This manual contains new and updated information.

New and Updated Information

This table contains the changes made to this revision.

Topic	Page
Updated the Resolver Interface Board Testpoint Locations image to reflect the new resolver interface board.	39
Updated the Resolver Feedback and Interface Circuit Board Removal and Installation procedures to reflect the new resolver interface board.	53
Updated the Test With the Motor, Without a Mechanical Load procedure and corrected the chapter number in the header for Chapter 4.	109
Updated the Drive Interconnection Diagram.	112
Updated the Power Feedback Connections Diagram.	113
Added the SCR to Pulse Transformer Board Gate Lead Pinout - Regenerative Drive Diagram.	114
Added the SCR to Pulse Transformer Board Gate Lead Pinout - Non-regenerative Drive Diagram.	114

Notes:

Access Procedures

Chapter 3

About This Publication

This manual contains hardware service information for frame A PowerFlex DC drives only. It is highly recommended that you obtain a copy of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001, which contains fault/alarm and programming information to assist you in troubleshooting drive errors and determining if repairs are necessary.

Who Should Use this Manual

This manual is intended for qualified service personnel responsible for troubleshooting and repairing PowerFlex DC drives. You should have previous experience with, and basic understanding of, electrical terminology, procedures, required troubleshooting equipment, equipment protection procedures and methods, and safety precautions.

Additional Resources

Additional drive service and software or firmware support information is available on the Allen-Bradley Drives Service and Support website: http://www.ab.com/support/ abdrives/.

A complete list of spare parts for PowerFlex DC drives is available on the Allen-Bradley web site at: www.ab.com/support/abdrives/powerflexdc/PowerFlex_DC_Released_Parts.pdf

The following table lists publications that provide general drive information:

Title	Publication
Preventive Maintenance of Industrial Control and Drive System Equipment	DRIVES-TD001
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control	SGI-1.1
A Global Reference Guide for Reading Schematic Diagrams	100-2.10
Guarding Against Electrostatic Damage	8000-4.5.2

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

Notes:

Before You Begin Testing, Maintenance or Repairs

Introduction

This chapter provides information you should know before you begin tests, maintenance or repairs on drive components.

General Safety Precautions

Read the following precautions before you begin testing components, performing maintenance or repairing the drive.

ATTENTION: Only qualified personnel familiar with DC drives and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

ATTENTION: This drive contains **ESD** (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference A-B publication 8000-4.5.2, "Guarding Against Electrostatic Damage" or any other applicable ESD protection handbook.

ATTENTION: Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment. Hazardous voltages may exist in the drive enclosure even with the circuit breaker in the off position. Recommended practice is to disconnect and lock out control equipment from power sources. If it is necessary to work in the vicinity of energized equipment, the safety related work practices of NFPA 70E, Electrical Safety Requirements for Employee Workplaces, must be followed. DO NOT work alone on energized equipment.

ATTENTION: Potentially fatal voltages may result from improper usage of an oscilloscope and other test equipment. The oscilloscope chassis may be at a potentially fatal voltage if not properly grounded. If an oscilloscope is used to measure high voltage waveforms, use only a dual channel oscilloscope in the differential mode with X 100 probes. It is recommended that the oscilloscope be used in the A minus B Quasi-differential mode with the oscilloscope chassis correctly grounded to an earth ground.

ATTENTION: Remove power before making or breaking cable connections. When you remove or insert a cable connector with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine motion
- causing an explosion in a hazardous environment

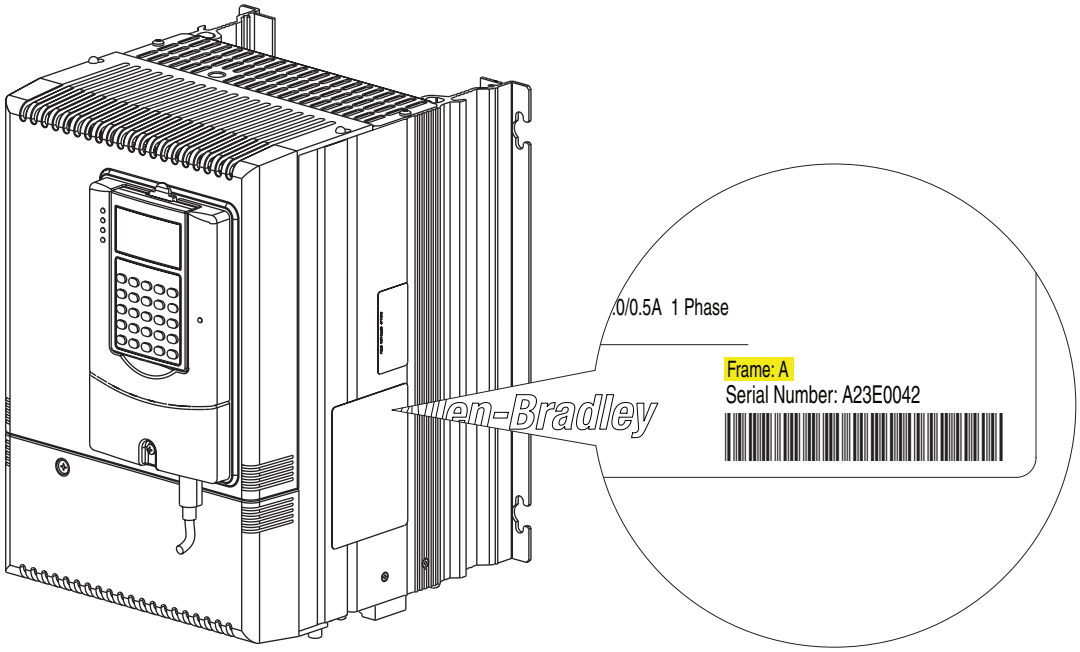
Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.

ATTENTION: HOT surfaces can cause severe burns. **Do not** touch the heatsink surface during operation of the drive. After disconnecting power allow time for cooling.

Hardware Description

The PowerFlex DC drive contains a power structure that has an armature and field supply. The armature supply consists of a three–phase, full wave rectified, dual bridge, capable of two or four quadrant output. The field supply consists of single phase, full wave rectified bridge. Also associated with the power structure are incoming line protection devices and contactor and dynamic brake control circuits.

Verify that you are working on a Frame A drive by checking the data nameplate located on the side of the drive. The frame size is printed just above the serial number in the lower right corner of the label.



Commonly Used Tools

Service Tools

This list of basic service tools which will cover needs of tools for repair and maintenance measurements.

Item	Details
Digital Multimeter	Digital multimeter, capable of ac and dc voltage, continuity, resistance and forward diode bias tests. Fluke model 87 III or equivalent (recommended).
Oscilloscope	Portable, digitizing, dual channel scope, with isolation
Current clamp	3x drive rated armature current output
Soldering station	Soldering / de soldering
Torque wrench	1...12 N•m
Torque wrench	6...50 N•m
box wrench	7 mm, 8 mm, 10 mm, 13 mm, 17 mm, 19 mm, 22 mm
socket extension	230 mm
Wrench	7 mm, 8 mm, 10 mm, 13 mm, 17 mm, 19 mm, 22 mm
Wire cutter	
Nose pliers	
Crimping tools	For cable terminals 1.5...240
Angle wrench	
Screw drivers:	
Flat nose	7x2 mm
Phillips®	#1, 2, 3
Hexagonal wrench	#4, 5, 6
ESD-protected place of work	Working surface, Floor covering, seat and ground connections
ESD-protective clothing	Wrist wrap, shoes, overall clothing (coat)

Phillips® is a registered trademark of Phillips Screw Company.

Software Tools

DriveTools™ SP, DriveExecutive, DriveExplorer™ and DriveObserver™ are software tools for uploading, downloading and monitoring system parameters.

Component Test Procedures

Introduction

This chapter provides general procedures for inspecting and testing the major components of the drive and includes recommendations for repairs. Due to the technical nature of this product and the variety of possible applications, not all possible fault conditions and troubleshooting solutions can be described in this manual.

IMPORTANT Using the diagnostic tests in this chapter should only be performed by qualified personnel and only when other corrective actions have failed. All tests assume that the control board connections have been properly made.

For common drive symptoms and corrective actions and fault troubleshooting information, see Chapter 4 "Troubleshooting" in the PowerFlex Digital DC Drive User Manual, publication 20P-UM001.

Save the Parameter Configuration

It is recommended that you save the drive and communication adapter parameter configuration to a HIM Set or by up loading the drive and adapter parameters to an offline node file using DriveExecutive™ before performing any service or testing on the drive. HIM sets are files stored in permanent nonvolatile HIM memory.

Save to a HIM Set

Complete these steps to save the drive and adapter parameters to a HIM set.

1. On the HIM, access the **Memory Storage** menu.
2. Select the **HIM CopyCat** menu and press .
3. Select **Device** -> **HIM** and press .
4. Do one of the following:
   - If there are no existing HIM Sets, enter a name using the and buttons to select the desired characters and press .
   - If there is an existing HIM Set, press to overwrite it, or select **No** using the button and use the and buttons to select the desired characters. Then press .

The HIM Set will be saved to nonvolatile memory.

Download Parameters to an Offline Node File

You can save all drive and adapter parameters in the drive to an offline database file on your computer using DriveExecutive. An offline node file (*.dno) contains all information about the node, including the necessary databases.

1. From the **Drive** menu, select **Upload from Drive** or click the upload button on the toolbar.
2. Click **Yes** to confirm the operation, which cannot be undone.
3. If you are not connected to a drive, the Connect to Drive dialog displays. Select the drive to which you want to connect and click **OK**.
4. A dialog displays the status of the upload operation. Click **Cancel** to cancel the operation.

Visual Component Inspection

Visually inspect the drive circuit boards and power components before energizing the drive for any of the component test procedures.

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive. Refer to Remove Power from the Drive on page 44.
3. Remove the protective covers from the drive. Refer to Protective Cover Removal and Installation on page 48.
4. Check components for burn marks, breakage or foil delamination on all circuit boards.

   Replace any of these components without further testing if they show evidence of burn marks, breakage or foil delamination.

Troubleshoot a Control Power Supply Failure

If a drive Power Failure fault (F3) has occurred and the drive is inoperable via the HIM or other means of control, compete the steps below to determine where the control power failure has occurred.

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive. Refer to Remove Power from the Drive on page 44.
3. Remove the protective covers from the drive. Refer to Protective Cover Removal and Installation on page 48.
4. Measure the signal voltage at the testpoints as indicated in the following table.

Name	Testpoint	For Testpoint Location See…	Associated Connector-Pin	Description
+ 5V	XY5	Figure 1 on page 20	XA-1 / XA-3 / XA-5	+5V digital supply
GNDD	XY6	Figure 1 on page 20	XA-2 / XA-4 / XA-6	+5V digital supply ground
GNDD	XY7	Figure 2 on page 21	XA-2 / XA-4 / XA-6	+5V digital supply ground
+15V	XY12	Figure 1 on page 20	XA-9 / XA-10	+15V analog supply
GNDA	XY10	Figure 1 on page 20	XA-11 / XA-12	15V analog supply ground
-15 V	XY11	Figure 1 on page 20	XA-13 / XA-14	-15V analog supply
+24V	XY8	Figure 1 on page 20	XA-16	+24V terminal block
GNDV	XY9	Figure 1 on page 20	XA-15	+24V terminal block ground
+5VEXP	+5VEXP	Figure 2 on page 21	XP3-1 / XP3-2 / XP3-3	+5V for DPI expansion
+12VEXP	+12VEXP	Figure 2 on page 21	XP3-4 / XP3-5	+12V for DPI expansion
0VEXP	0VEXP	Figure 2 on page 21	XP3-7 / XP3-8 / XP3-9	DPI expansion ground

Note: For a flow chart version of the steps that follow, see Control Power Supply Failure on page 128.

5. If any of the signals in the table above is incorrect or missing, verify that either 115 VAC or 230 VAC voltage is present at terminals U2 and V2 (control circuit power input).
   - If the voltage is present and correct, continue with step 5 below.
   - If the voltage is incorrect or missing, remove control power and verify the wiring and power source to U2, V2 and correct any problems. Test the voltage level again to verify that it is correct. If the voltage is correct, but the drive is still inoperable, continue with step 5 below.
6. Remove AC control power from terminals U2 and V2 and remove and test the fuse (F1) at the top of the drive. See Switching Power Supply Fuse Removal and Installation on page 45 for fuse location.
   - If the fuse is blown, continue with step 6 below.
   - If the fuse is not blown, replace the switching power supply board.
7. Replace the fuse on the switching power supply board. See Switching Power Supply Fuse Removal and Installation on page 45.
8. Disconnect the cable at connector XA on the control board. See Figure 27 on page 125 for location of connector XA.
9. Apply AC control power to the drive.
   - If the fuse blows, continue with Testing the Switching Power Supply and Pulse Transformer Boards below.
   - If the fuse does not blow, continue with Testing the Control and Field Board Connections on page 19.

Testing the Switching Power Supply and Pulse Transformer Boards

1. Replace the fuse on the switching power supply board. See Switching Power Supply Fuse Removal and Installation on page 45.
2. Remove the switching power supply board from the pulse transformer board. See Remove the Pulse Transformer and Switching Power Supply Circuit Board on page 66.
3. Reapply power to the switching power supply board only.
   - If the power supply fuse does not blow, continue with step 5 below.
   - If the power supply fuse blows, replace the switching power supply board.
4. Remove all incoming AC voltage from the drive.
5. Check all external wiring connected to the pulse transformer board, including the motor PTC if used, for a possible short circuit condition. Repair any short circuit conditions if found.
6. If no short circuit conditions exist, replace the pulse transformer board.

Testing the Control and Field Board Connections

1. Using an ohmmeter, check all input and output wiring on terminals 1...40 on terminal blocks TB1 and TB2 on the control board for a possible short circuit condition. Repair any short circuit conditions if found.
2. If an encoder and/or tachometer is used, use an ohmmeter to check all wiring on the respective terminals for a possible short circuit condition. Repair any short circuit conditions if found.
3. Remove the cables from connector XR and XFCD on the control board and use an ohmmeter to check between all voltage test points and common on the control board for possible short circuit conditions. The ohmmeter measurements should be greater than 200 kΩ. If any low resistance measurements are found, replace the control board.
4. Using an ohmmeter, measure between pins 1 and 2 and pins 3 and 2 on the XFCD cable connector. The resistance measurement for both tests should be greater than 200 kΩ. If a lower resistance value is measured, replace field board.

Figure 1 - Control Board Testpoints - Upper Left

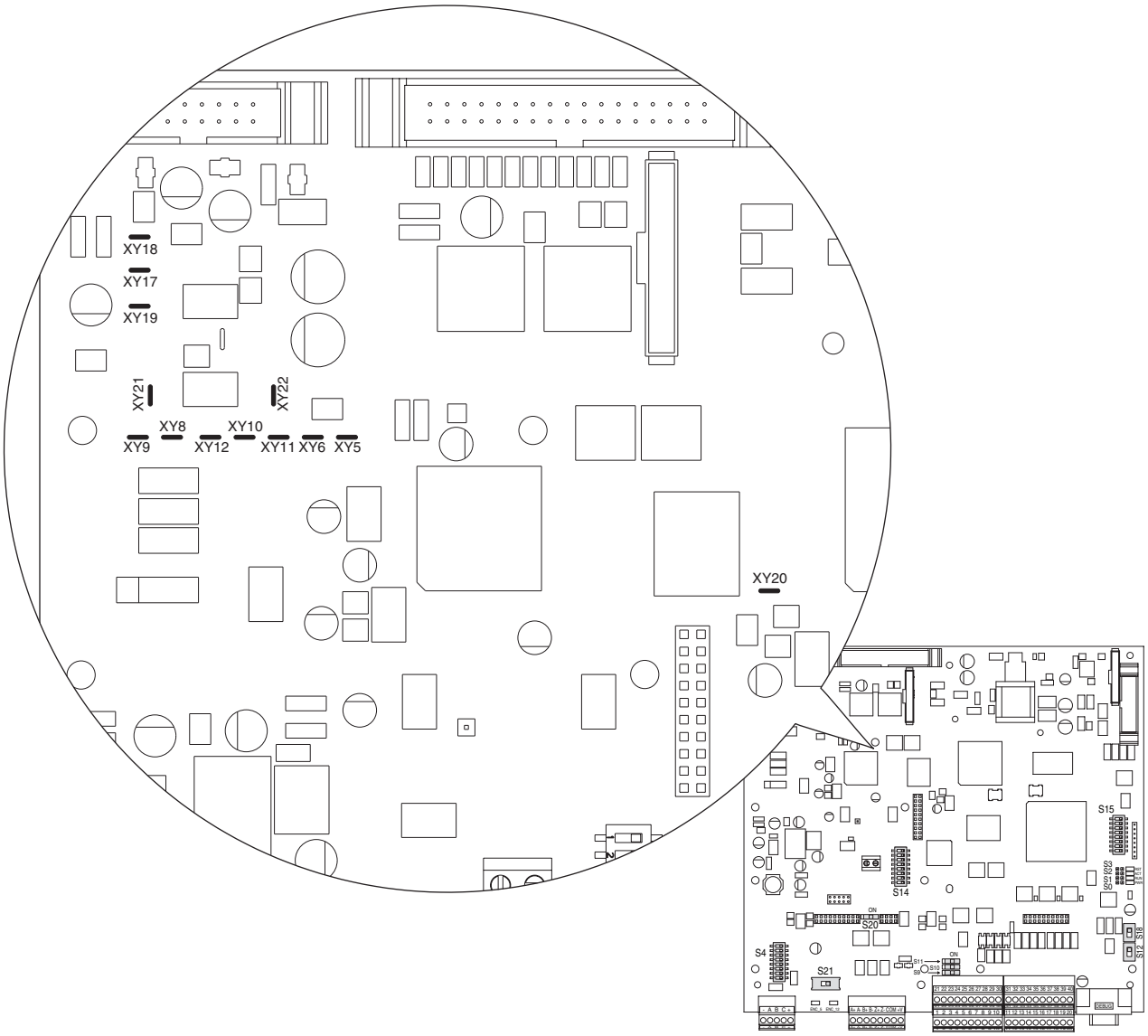
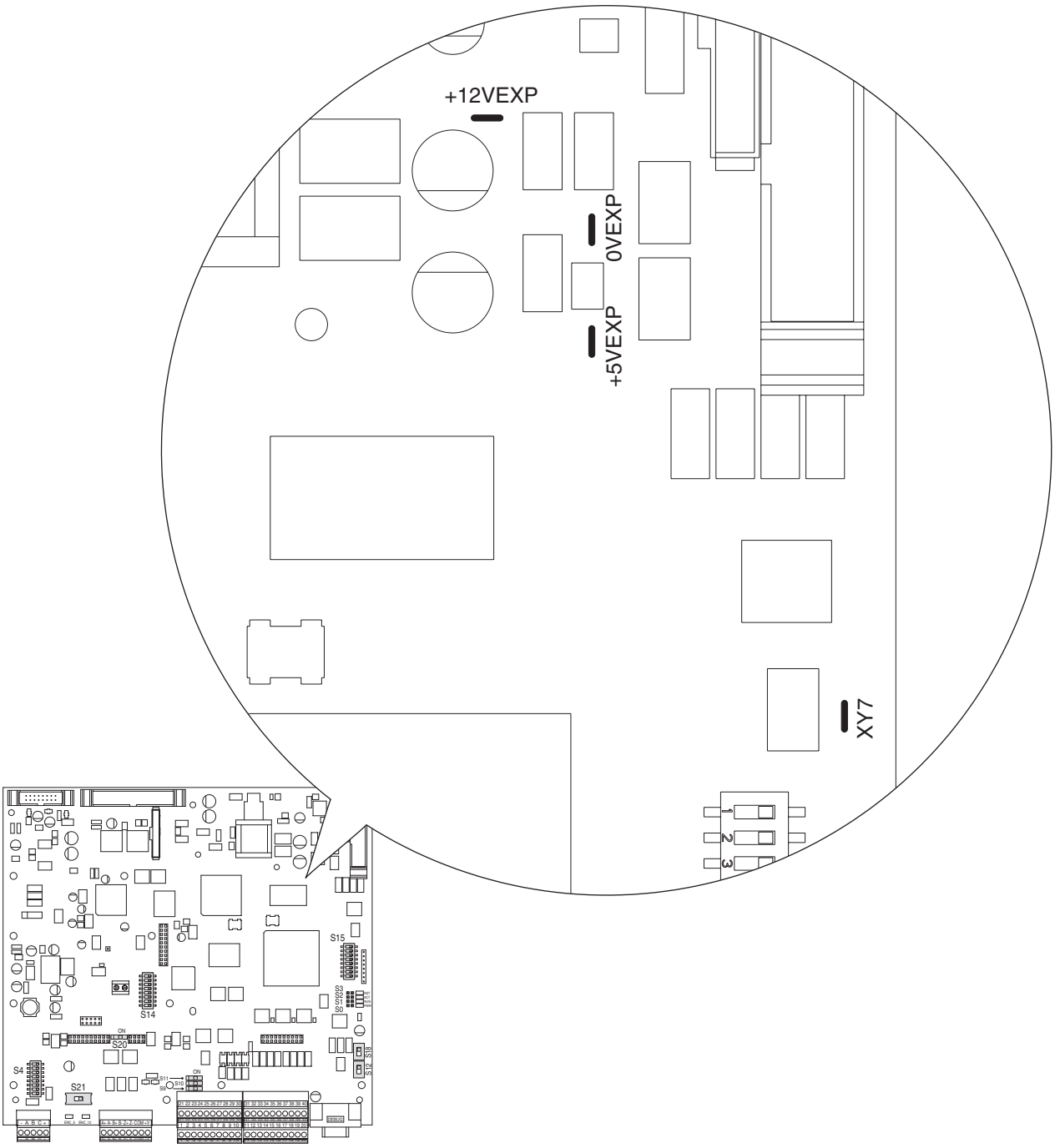


Figure 2 - Control Board Testpoints - Upper Right



Troubleshoot an AC Undervoltage Fault

If the drive faults with an AC Undervoltage Fault (F4), or parameter 466 [AC Line Voltage] does not equal the expected incoming AC line voltage, measure the AC line input signals as directed in the steps below.

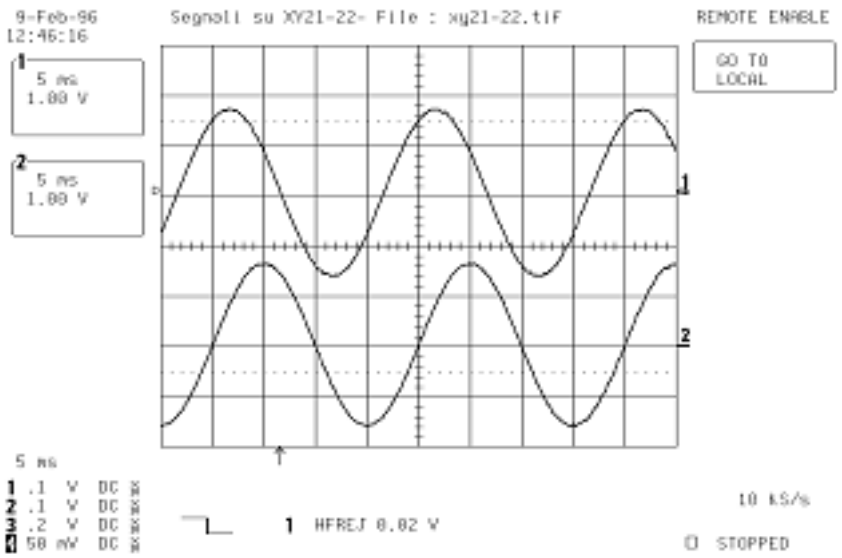
1. Read the General Safety Precautions on page 12.
2. Remove the protective covers from the drive. Refer to Protective Cover Removal and Installation on page 48.
3. Using a voltmeter, measure the voltage at terminals U, V, and W of the drive.

   Note: If an AC input contactor is used, the voltage must be measured on both the input and output sides of the contactor.

   If any of the voltage measurements is incorrect or missing, remove incoming AC power and verify the wiring to the drive and the power supply source and correct any problems.
4. Using a voltmeter, measure the combined voltages of the AC lines on the following testpoints on the control board (all waveforms have a 2.5V offset). See Figure 1 on page 20 and Figure 2 on page 21 for location of the testpoints. Also, see Figure 13 on page 113 for a schematic diagram.

Table 1 - Combined AC Line Input Signal Testpoints

Incoming AC Line Voltage	Phases	Measure From Testpoint	...	To Testpoint	Peak to Peak Measurement	RMS Measurement
240 VAC	V and U	XY22	...	XY18	1.42 VAC	0.500 V
	V and W	XY21	...	XY18		
480 VAC	V and U	XY22	...	XY18	2.95 VAC	1.040 V
	V and W	XY21	...	XY18		
575 VAC	V and U	XY22	...	XY18	2.85 VAC	1.007 V
	V and W	XY21	...	XY18		
690 VAC	V and U	XY22	...	XY18	3.45 VAC	1.220 V
	V and W	XY21	...	XY18		



- If any of the voltage measurements above are incorrect or missing, continue with step 5 below.
- If the voltage measurements above are correct but the value of parameter 466 [AC Line Voltage] is incorrect, replace the control board.

5. Remove the ribbon cable connected to XR on the control board and pulse transformer board and test the continuity of the cable using the measurements in Table 22 on page 122.

   If the measurements on the XR cable are correct, replace the pulse transformer board.

Troubleshoot an Armature Bridge Failure

If the drive is running unstable or faults with an Overcurrent Fault (F13) an armature bridge failure may have occurred. All of the signals going to and coming from the SCR bridges are transmitted via the ribbon cable connected to XR on the control board and can be measured at these points. See Figure 27 on page 125 for location of the XR connector on the control board.

Note: If using an AC input contactor, this step requires that the cable remain connected to the XR connector on the control board and that an adapter be used to measure these signals.

1. Read the General Safety Precautions on page 12.
2. Remove the protective covers from the drive. Refer to Protective Cover Removal and Installation on page 48.
3. If using a DC output contactor, disconnect the cable from XR on the control board and measure the signal for each SCR gate as indicated in the table below:

Signal Name	XR Cable Pin	Gate		Note
		MP	MN	
IT1	27	G1	G04	
IT2	29	G2	G05	
IT3	31	G3	G06	
IT4	21	G4	G01	
IT5	23	G5	G02	
IT6	25	G6	G03	
MN	33	–	–	Negative bridge MN - active when high (+5V)
MP	34	–	–	Positive bridge MP - active when high (+5V)

Figure 3, Figure 4, and Figure 5 below are examples representing gate pulse, current and voltage signal measurements taken on an SCR. In the figures below:

- The current signal is taken on the testpoint XY17 (+2.5V offset; +0.6V=Drive size current).
- The voltage signal is taken on the testpoint XY19 (+2.5V offset).
- The ground signal is taken on either testpoint XY10 or XY18.

Figure 3 - Good SCR Gate Pulse and Armature Current Signals Example

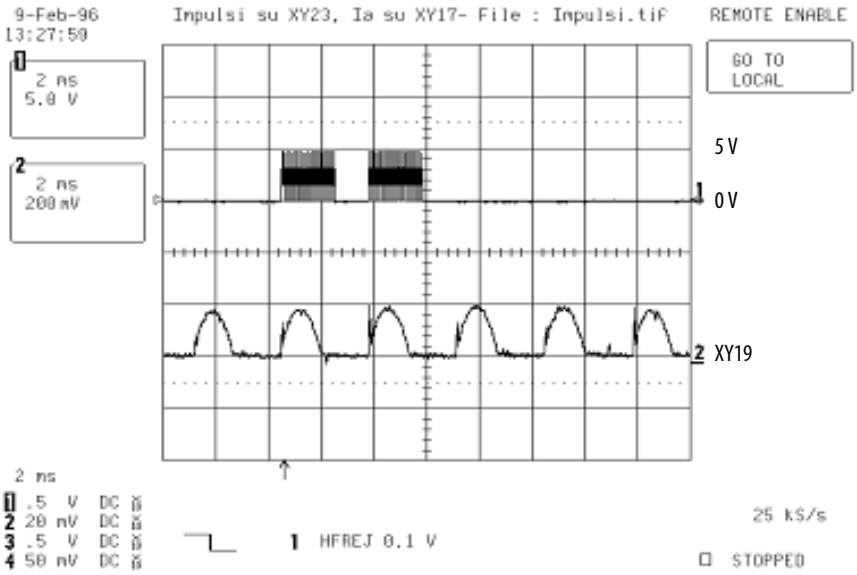
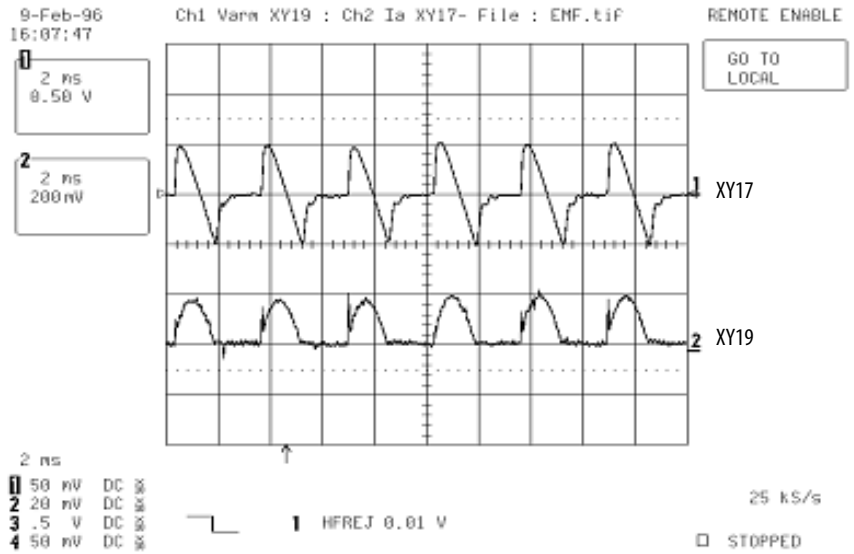
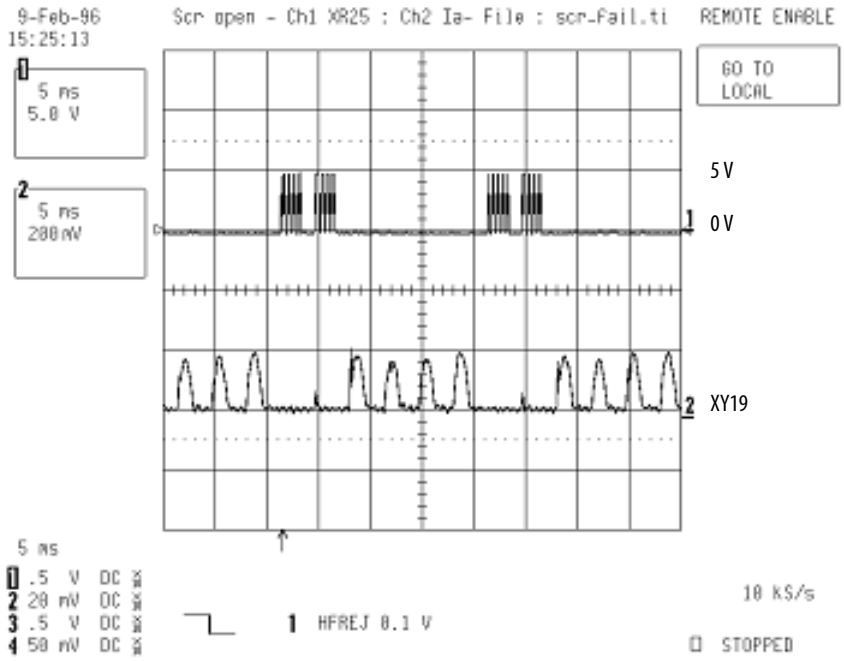


Figure 4 - Good SCR Armature Voltage and Motor Current Signal Example



A malfunctioning thyristor is connected to the relative gate. For example, if the tested signal is at XR25 and the positive bridge is active (MP high) from the following figure you can deduce that SCR connected to gate G6 is open.

Figure 5 - Open Thyristor Example



Troubleshoot a Field Current Loss Fault

If the drive faults with a “Field Current Loss” fault (F6) and there is low or incorrect field current present at the motor, as seen in parameter 351 [Field Current], complete the steps in Low or Incorrect Field Current below. If the drive faults with a “Field Current Loss” fault (F6) and there is no field current present at the motor, as seen in parameter 351 [Field Current], complete the steps in No Field Current on page 27.

Low or Incorrect Field Current

Note: For a flow chart version of these steps, see Low or Incorrect Field Current on page 130.

1. Read the General Safety Precautions on page 12.
2. Verify the actual value of parameter 351 [Field Current] by measuring the DC motor field current using a DC clamp.
3. Verify that the drive rated field bridge current is set correctly in parameter 374 [Drv Fld Brdg Cur] and DIP switch S14 is configured to correctly (according to the instructions in the PowerFlex Digital DC Drive User Manual, publication 20P-UM001) and make any necessary corrections. See Control Board on page 125 for DIP switch location.
4. Verify that the value of parameter 280 [Nom Mtr Fld Amps] matches the rated field current value on motor nameplate and make any necessary corrections.
5. Remove the protective covers from the drive. Refer to Protective Cover Removal and Installation on page 48.
6. Measure the field current signal on the green LA-LB terminal located on the control board: LA is the ground and LB is field current signal. The measured value of the field current at LA-LB should be equal to the value of parameter 374 [Drv Fld Brdg Cur]. If these values are equivalent, the voltage across these terminals should be 1.66 VDC.

   Note: For lower field current values, the voltage will be proportional. For example, if the field is set up for 2 A and the motor is rated for 1.5 A, the measurement at LA-LB will be 1.245 VDC (1.5 / x = 2 / 1.66).

   - If the voltage measurement is incorrect, continue with step 7 below.
   - If the voltage measurement is correct, but the “Field Current Loss” fault still exists, replace the control board.
7. Using an ohmmeter, measure the resistance across terminals LA-LB to verify that the value equals the equivalent resistance as indicated in the table below (set with DIP switch S14 on the control board).

Field Curr Scale	Field Supply	S14-1	S14-2	S14-3	S14-4	S14-5	S14-6	S14-7	S14-8	Equivalent Resistance
1 A	10 A	OFF	OFF	OFF	OFF	OFF	ON	Not Used		1668
2 A	10 A	OFF	OFF	OFF	OFF	ON	OFF			845
3 A	10 A	OFF	OFF	OFF	OFF	ON	ON			560.9
5 A	10 A	OFF	ON	OFF	OFF	OFF	OFF			333.3
10 A	10 A	ON	OFF	OFF	OFF	OFF	OFF			168.5
13 A	14 A	ON	OFF	OFF	OFF	ON	ON			129.6

   - If the resistance measurement is incorrect, replace the field board.

No Field Current

Note: For a flow chart version of these steps, see No Field Current on page 129.

1. Read the General Safety Precautions on page 12.
2. Remove the protective covers from the drive. Refer to Protective Cover Removal and Installation on page 48.
3. Verify that the correct AC voltage is present at terminals U1 and V1 on the bottom of the drive. See Figure 17 on page 115 for a schematic diagram.
   - If the voltage is correct, continue with step 4 below.
   - If the voltage is incorrect or missing, remove power from the drive and verify the wiring to the drive and the power supply source and correct any problems. Test the voltage level again to verify that it is correct. If the voltage is correct, but the fault persists or parameter 351 [Field Current] is incorrect, continue with step 4 below.
4. Remove AC power to the drive and check the fuses at FU1 and FV1.
   - If the fuses are blown, complete the steps in Test Field Wiring and Voltage Signals on page 27.
   - If the fuses are not blown, complete the steps in Test Field Control Signals on page 27.

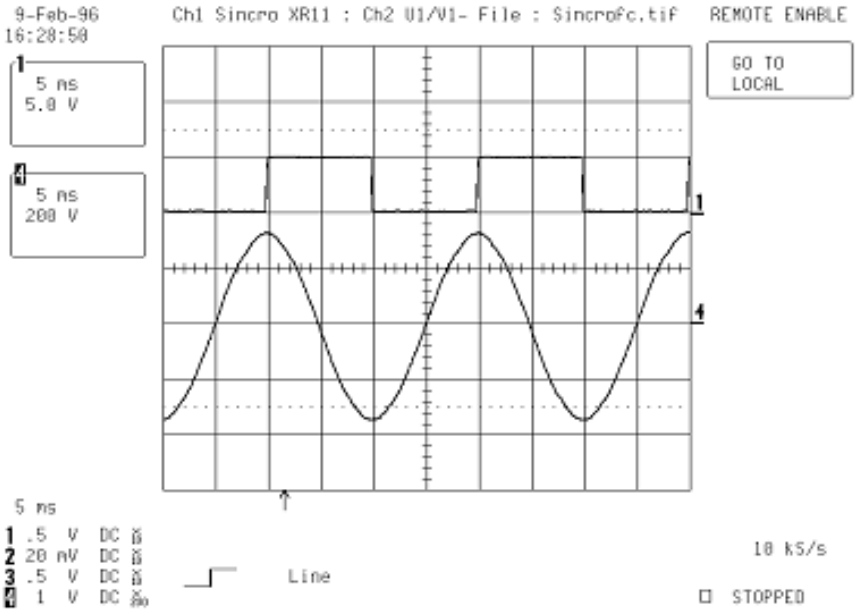
Test Field Wiring and Voltage Signals

1. Test the resistance of the motor field wiring and motor field for possible short circuits.
   - If there are no short circuits, continue with step 2 below.
   - If a short circuit exists, correct any problems.
2. Check the field SCR/dual diode module for a short circuit condition. See Check the Field SCR/Dual Diode Module on page 36.
   - If there are no short circuits, continue with step 3 below.
   - If a short circuit exists, replace the field SCR/dual diode module.
3. Replace the field fuses at FU1 and FV1 and apply power to the drive.
4. If the field fuses blow, replace the field board.

Test Field Control Signals

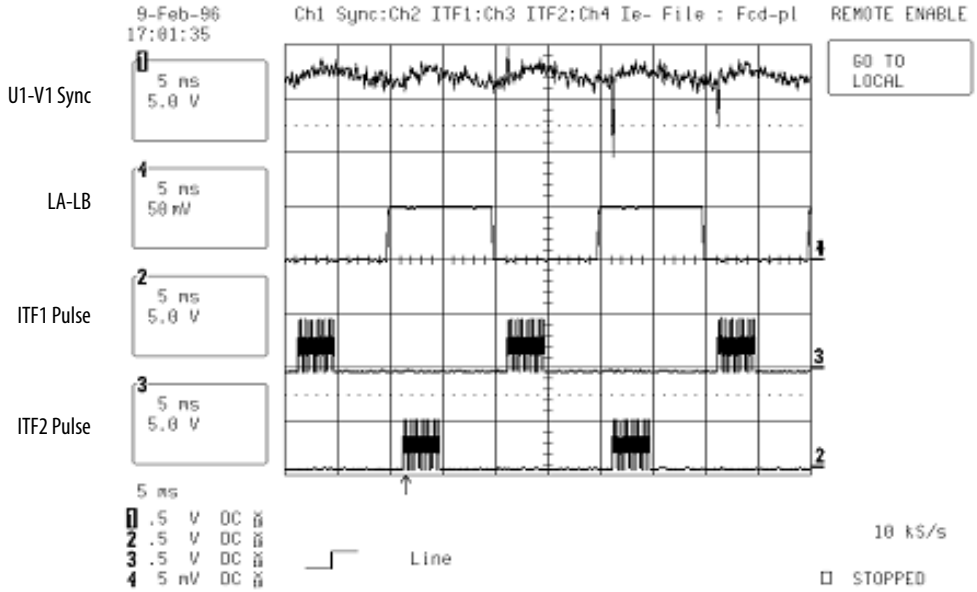
1. Disconnect the cable from connector XR on the control board and measure the U1-V1 voltage synchronization signal at pin 11 on the cable. See Figure 27 on page 125 for location of the XR connector on the control board.

This signal is a square wave signal with a 90° lag phase displacement compared to the AC voltage signal.



2. Measure the gate signals at pins XR-1 and XR-2 on the cable. The figure below displays the following signals from top to bottom:

Channel	Signal
1	U1-V1 Sync
4	Ie - LEM current feedback signal taken on LA-LB terminal
2	ITF1 pulse
3	ITF2 pulse



- If the gate signals are missing, replace the control board.
- If the gate signals are present, replace the field board.

Power Component Test Procedures

Check the Armature SCR Modules

The frame A PowerFlex DC drive armature supply consists of three (non-regenerative drives) or six (regenerative drives) SCR modules mounted on the main heat sink. A malfunction of any of these devices will be indicated by either an Overcurrent fault (F13), blown or tripped incoming protection devices, or erratic motor operation. The following procedure can be used if an armature bridge component malfunction is suspected.

1. Read the General Safety Precautions on page 12.
2. Remove and lock-out all incoming power to the drive. Refer to Remove Power from the Drive on page 44.
3. Verify that contactor power (if used) is removed.
4. Verify that power to an external field supply (if used) is removed.
5. Check the anode to cathode junction of each SCR. With a digital multimeter set to Ohms, measure the resistance across the SCRs (lead orientation is not critical). For regenerative drives, refer to Table 2 on page 30 and Figure 6 on page 30. For non-regenerative drives, refer to Table 3 on page 31 and Figure 7 on page 31. If a low resistance is detected, determine which SCR module(s) is/are damaged based on the tables below and replace that module(s). (Refer to SCR Module Removal and Installation on page 95.)

Table 2 - SCR Anode to Cathode Junction Measurements for Regenerative Drives

On SCR Module…	SCR…	Measure from Terminal…	To Terminal…	Nominal meter reading:
1	1	U	C	"open circuit" or "megaOhms" range
	4	U	D	
2	2	V	C	
	5	V	D	
3	3	W	C	
	6	W	D	
01	01	U	C	
	04	U	D	
02	02	V	C	
	05	V	D	
03	03	W	C	
	06	W	D	

Figure 6 - Regenerative Drive SCR Module Layout

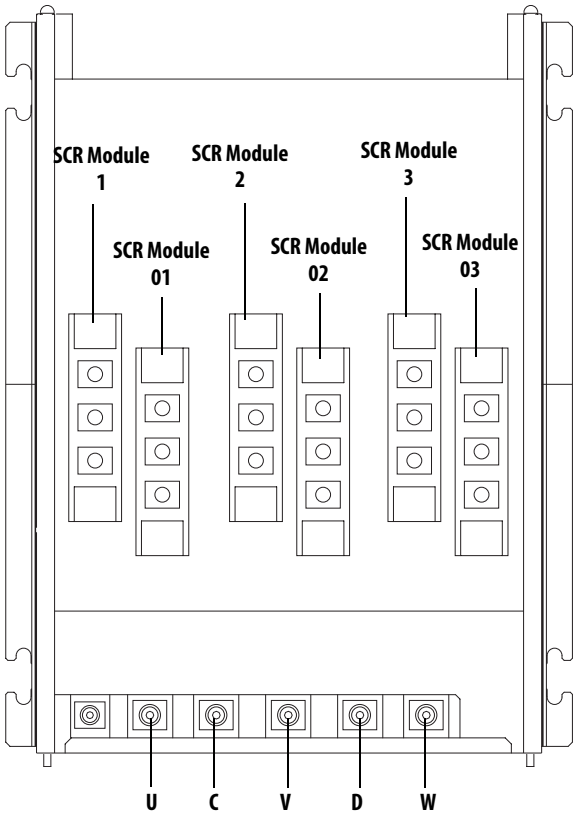
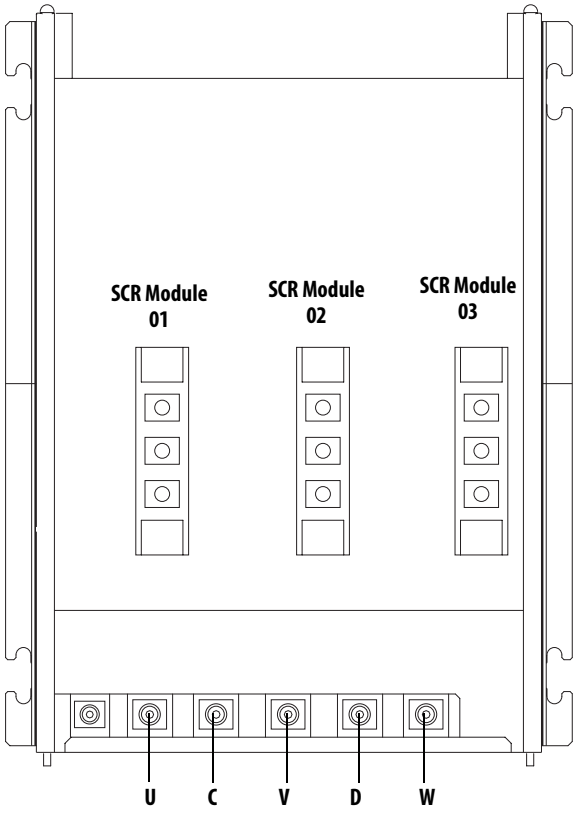


Table 3 - SCR Anode to Cathode Junction Measurements for Non-Regenerative Drives

On SCR Module…	SCR…	Measure from Terminal…	To Terminal…	Nominal meter reading:
01	01	U	C	"open circuit" or "megaohms" range
	04	U	D	
02	02	V	C	
	05	V	D	
03	03	W	C	
	06	W	D	

Figure 7 - Non-Regenerative Drive SCR Module Layout



6. Check the gate to cathode junction of each SCR. With a digital multimeter set to Ohms, measure the resistance of each SCR junction. For regenerative drives, refer to Table 4 and Figure 8 below. For non-regenerative drives, refer to Table 5 on page 33 and Figure 9 on page 33. If a measurement is outside of the range specified in the tables below or if one reading deviates significantly from the majority, then module replacement may be necessary. (Refer to SCR Module Removal and Installation on page 95.)

Table 4 - SCR Gate to Cathode Junction measurements for Regenerative Drives

On SCR Module…	SCR…	Measure from …	To…	Nominal meter reading:
1	1	Pin 5	Pin 4	5…20 Ω(1)
	4	Pin 6	Pin 7	
2	2	Pin 5	Pin 4	
	5	Pin 6	Pin 7	
3	3	Pin 5	Pin 4	
	6	Pin 6	Pin 7	
01	01	Pin 6	Pin 7	
	04	Pin 5	Pin 4	
02	02	Pin 6	Pin 7	
	05	Pin 5	Pin 4	
03	03	Pin 6	Pin 7	
	06	Pin 5	Pin 4	

(1) The actual reading varies depending upon the SCR manufacturer. Verify that the actual measured value is consistent for all SCRs.

Figure 8 - SCR Connection Pinouts for Regenerative Drives

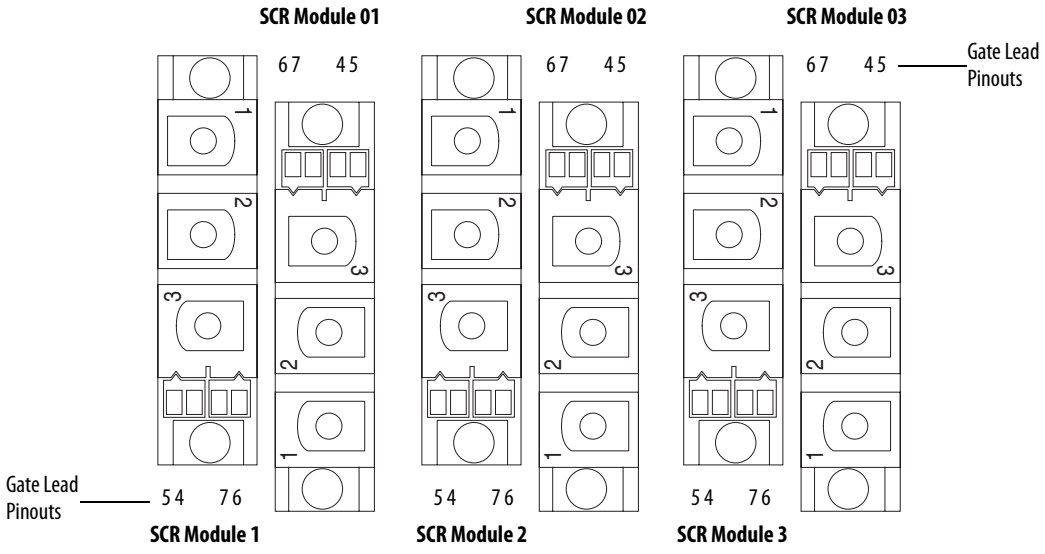
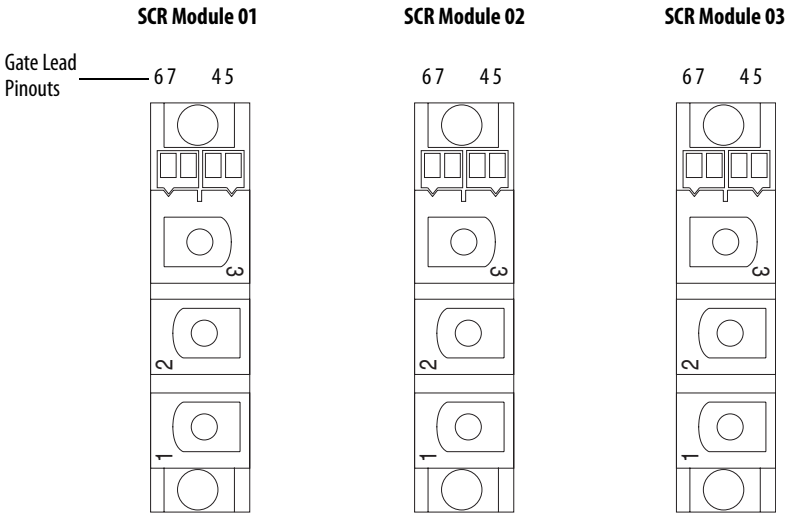


Table 5 - SCR Gate to Cathode Junction Measurements for Non-Regenerative Drives

On SCR Module…	SCR…	Measure from …	To…	Nominal meter reading:
01	01	Pin 6	Pin 7	5…20 Ω(1)
	04	Pin 5	Pin 4	
02	02	Pin 6	Pin 7	
	05	Pin 5	Pin 4	
03	03	Pin 6	Pin 7	
	06	Pin 5	Pin 4	

(1) The actual reading varies depending upon the SCR manufacturer. Verify that the actual measured value is consistent for all SCRs.

Figure 9 - SCR Connection Pinouts for Non-Regenerative Drives

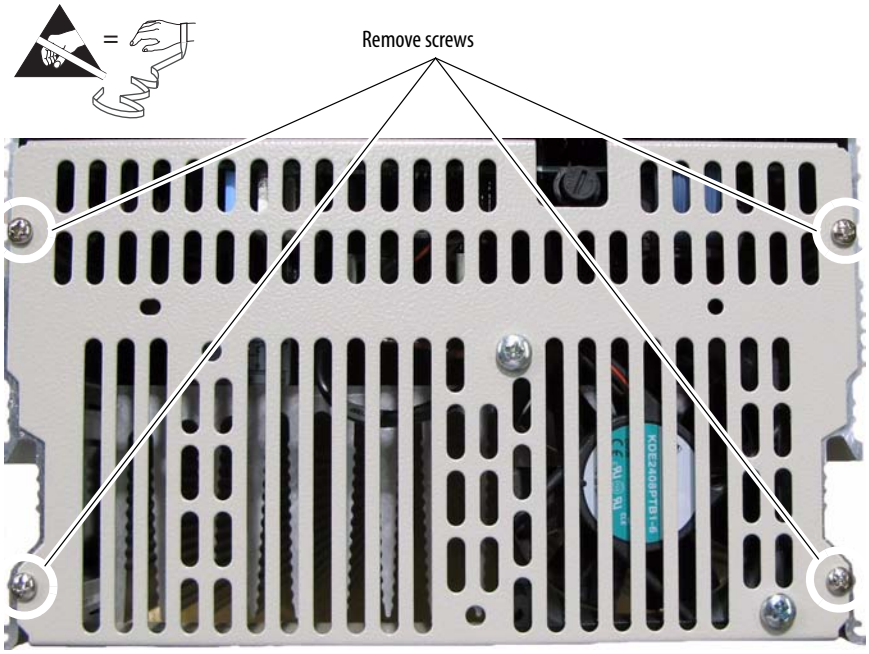


Check the Pulse Transformer Board

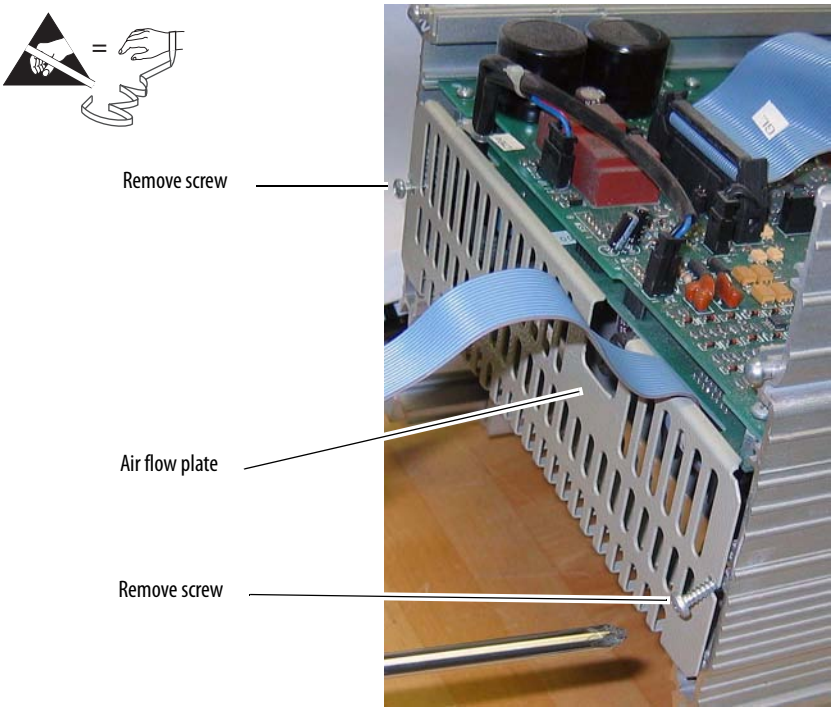
The armature pulse transformer circuit board contains an isolated gate firing circuit and also provides dv/dt protection for the armature SCR modules. A malfunction of these devices will be indicated by either an Overcurrent fault (F13), blown or tripped incoming protection devices or erratic motor operation. Use the following procedure if a malfunction in this circuitry is suspected.

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (refer to Remove Power from the Drive on page 44).
3. Remove the protective covers (refer to Protective Cover Removal and Installation on page 48).
4. Remove the control EMI shield and control board (refer to Control EMI Shield and Control Circuit Board Removal and Installation on page 64).

5. Remove the slotted air flow plate from the top of the drive.
   - For 38A/10 HP and 55A/15 HP drives with 230V AC input and 35A/20 HP, 45A/25 HP, and 52A/30 HP drives with 460V AC input, remove the four screws that secure the slotted air flow plate to the top of the drive, remove the fan cable from connector XV on the switching power supply board and remove the plate.



   - For all other drives, remove the two screws that secure the slotted air flow plate to the top of the drive and remove the plate.



IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

6. Remove the pulse transformer board (refer to Pulse Transformer and Switching Power Supply Circuit Board Removal and Installation on page 66).

   Note: The switching power supply board is mounted on the back of the pulse transformer board but does not need to be removed from the pulse transformer board for this test.

7. With a digital multimeter set for a "continuity check", measure each connection point on the pulse transformer board listed in the tables below. Refer to Figure 25 on page 120 for connector locations. If any of the actual measurements are out of tolerance, replace the pulse transformer board.

Table 6 - Armature Pulse/Snubber Circuit Measurements for Regenerative Drives

For SCR	Measure From . . .	To . . .	Meter reading:	Connector XY Pinout
1	KG1	XY-4	"open circuit"	
4	KG4	XY-1		
2	KG2	XY-5		
5	KG5	XY-2		
3	KG3	XY-6		
6	KG6	XY-3		
01	KG01	XY-1		
04	KG04	XY-4		
02	KG02	XY-2		
05	KG05	XY-5		
03	KG03	XY-3		
06	KG06	XY-6		

Table 7 - Armature Pulse/Snubber Circuit Measurements for Non-Regenerative Drives

For SCR	Measure From . . .	To . . .	Meter reading:	Connector XY Pinout
01	KG01	XY-1	"open circuit"	
04	KG04	XY-4		
02	KG02	XY-2		
05	KG05	XY-5		
03	KG03	XY-3		
06	KG06	XY-6		

8. With the digital multimeter set to "diode test", measure each connection point on the pulse transformer board listed in the tables below. If any of the actual measurements are out of tolerance, replace the pulse transformer board.

Table 8 - Armature Pulse Transformer Primary Measurements for Regenerative and Non-Regenerative Drives

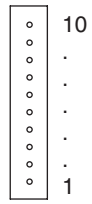
For SCR	(+) Meter Lead	(-) Meter Lead	Meter reading:	Connector XY Pinout
1/01	XY-8	XY-1	0.41 Ω	
4/04	XY-8	XY-4		
2/02	XY-8	XY-2		
5/05	XY-8	XY-5		
3/03	XY-8	XY-3		
6/06	XY-8	XY-6		

Table 9 - Armature Pulse Transformer Primary Measurements for Regenerative Drives

For SCR	(+) Meter Lead	(-) Meter Lead	Meter reading:	Connector XY Pinout
1	XY-7	XY-1	0.41 Ω	
4	XY-7	XY-4		
2	XY-7	XY-2		
5	XY-7	XY-5		
3	XY-7	XY-3		
6	XY-7	XY-6		

Check the Field SCR/Dual Diode Module

The field supply consists of a dual pack SCR/Dual Diode module arranged in a single–phase full wave rectifier configuration. Malfunction of either of these components may cause various responses including field and velocity related faults, or blown fuses. The following procedures can be used if field bridge malfunctions are suspected.

1. Read the General Safety Precautions on page 12.
2. Remove and lock-out all incoming power to the drive. Refer to Remove Power from the Drive on page 44.
3. Verify that contactor power (if used) is removed.
4. Verify that power to an external field supply (if used) is removed.
5. Check the anode to cathode junction of the field SCR/dual diode module. With the digital multimeter set to "diode test", measure the resistance across the modules. Refer to Table 10 on page 37 and Figure 10 on page 37.

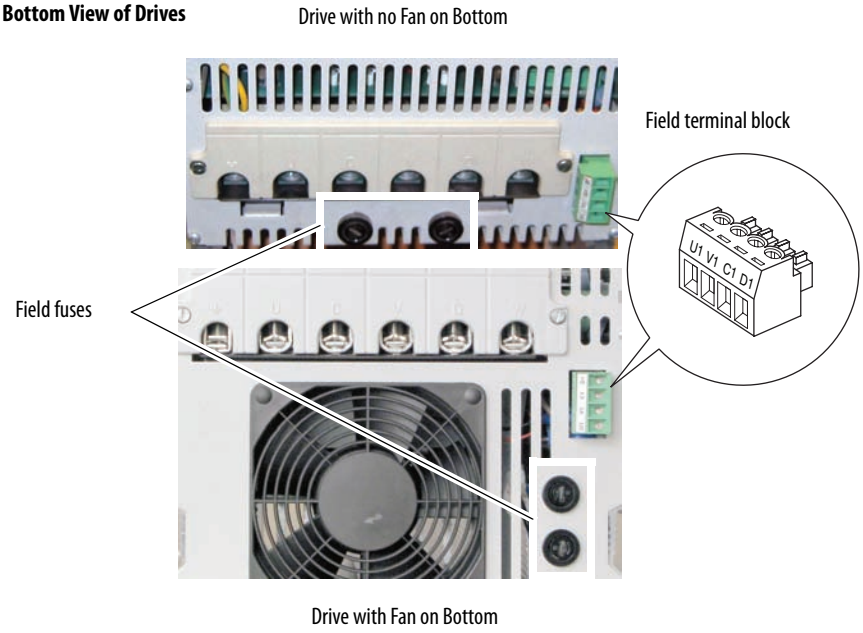
   If a low resistance is detected, replace the modules. (Refer to Field SCR/ Dual Diode Module and Field Circuit Board Removal and Installation on page 88.)

   If a measurement results in an "infinity" reading, check the fuses at FV1 and FU1 on the bottom of the drive to determine if they are open. See Figure 10 on page 37.

Table 10 - SCR/Dual Diode Module Anode to Cathode Junction Measurements

(+) Meter Lead Terminal	(-) Meter Lead Terminal	Nominal meter reading:
U1	C1	"open" or ∞
U1	D1	"open" or ∞
V1	C1	"open" or ∞
V1	D1	"open" or ∞
C1	D1	"open" or ∞
C1	U1	"open" or ∞
C1	V1	0.50V
D1	C1	0.50V
D1	U1	0.45V

Figure 10 - Field Terminal Block and Field Fuse Locations



6. Remove the cable from connector XP on the pulse transformer circuit board.
7. Check the gate cathode junction of the field SCR/dual diode module. With the digital multimeter set to "diode test" measure the resistance across the modules (lead orientation is not critical). Refer to Table 11 below.

   If a low resistance is detected, replace the SCR/dual diode module.

Table 11 - SCR/Dual Diode Module Gate Cathode Junction Measurements

Measure from…	To…	Nominal meter reading:
XP1	XP2	10…20 Ω
XP3	XP4	

Speed Feedback Device Tests

Check the Encoder

The encoder feedback device provides a dual channel quadrature output waveform and requires that the output be differential line drivers at +5 or +12...15V signal levels. The encoder power supply voltage and input selection is controlled by DIP switch S21 on the control board (see "DIP Switch and Jumper Settings" in the PowerFlex Digital DC Drive User Manual, publication 20P-UM001). The encoder power supply from the drive can be measured from +V (+) to COM (-) with a digital multimeter. If S21 is set to ENC_5, the voltage level should be +2.5...5.4V. If S21 is set to ENC_12, the voltage level should be +5.4V...15.2V. For reference, see Figure 20 on page 116 for a schematic diagram.

The Channel A and Channel B are square wave type outputs that are 90 degrees out of phase. When rotating in the CCW direction, as viewed from the commutator end, Channel A leads Channel B. Each differential channel has an inverted and non–inverted signal.

Power for the encoder is provided internally and is capable of 200mA of current with a current foldback feature that protects the power supply should the current draw exceed 200mA. If different power supply requirements exist for the chosen feedback device, the supply must be provided external to the drive.

The frequency is proportional to speed and the pulse rate of the encoder, referred to as the "Pulse/Rev" rating on the nameplate. The speed of the motor can be calculated by: Speed (RPM) = [Frequency (Hz) x 60]/[Pulses/Revolution].

Check the DC Tachometer

- Verify that DIP switch S4 on the control board is set to the correct input voltage of the DC analog tachometer. See "DIP Switch and Jumper Settings" in the PowerFlex Digital DC Drive User Manual, publication 20P-UM001. Also, see Figure 21 on page 117 for a circuit diagram.
- The analog tach signal is fine scaled using parameter 562 [Anlg Tach Gain].
- Refer to "Drive Reference and Feedback Scaling" in Appendix C of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001, for more information.

Check the Resolver Interface Board

The resolver feedback option module uses the resolver feedback board for resolver connections, and the resolver interface board for external power, status, feedback board reset, and encoder output connections.

If a "Resolver Error" (F93) fault occurs and the resolver wiring and configuration are correct, the following LED indicators and testpoints on the resolver interface board can be used to verify that the board is not damaged.

- Verify that the following LEDs are functioning as expected. See Figure 11 on page 40 for LED locations and switch settings.

LED Code	LED Color	On State	Off State
D3	Red	24V overload (fuse F1 blown). This fuse is self-resetting when it returns to normal operating temperature.	24V supply is OK.
D10	Green	12V supply is OK.	Loss of 12V power.
D11	Green	Resolver feedback board voltage is OK.	Voltage error on resolver feedback board.
D12	Blue	Switch S1 is set to +24V for encoder signal output on TB2.	S1is not set for +24V.
D16	Yellow	Switch S1 is set to +12V for encoder signal output on TB2.	S1 is not set for +12V.
D18	Green	Switch S1 is set to +5V for encoder signal output on TB2.	S1 is not set for +5V.
D26	Red	Resolver feedback board is in reset mode.	Resolver feedback board not in reset mode.

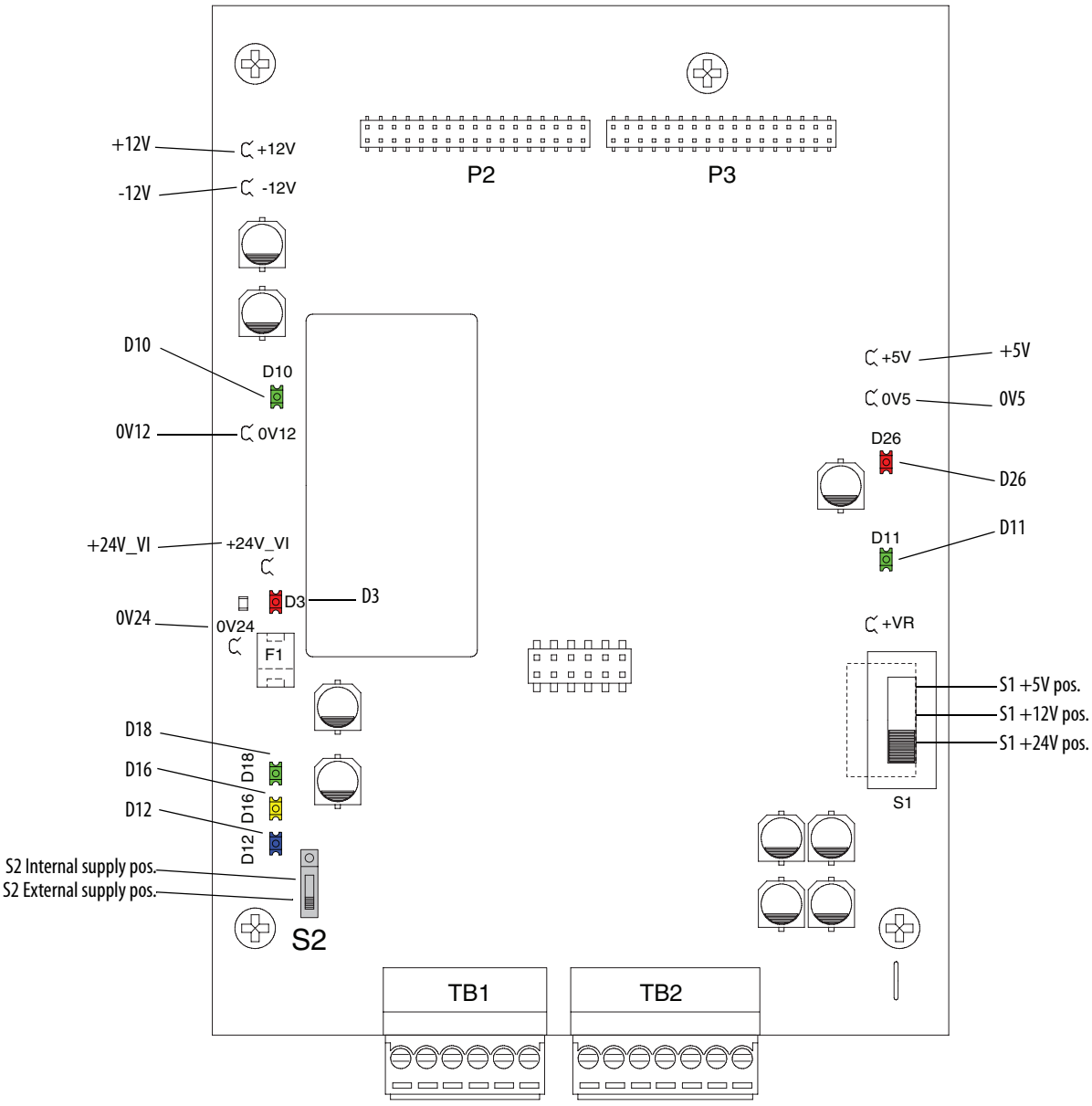
If any of the LEDs that should turn on when control power is applied fail to do so, verify that the resolver interface and resolver feedback boards are properly seated on the appropriate connectors (XRE, P2, P3). If problems persist, replace the resolver interface and/or resolver feedback board.

- Measure the signal voltage at the testpoints as indicated in the following table. See Figure 11 on page 40 for testpoint locations.

Testpoint	to	Testpoint	Measurement
+12V	...	0V12	12V DC ±5%
-12V	...	0V12	-12V DC ±5%
+24V_VI	...	0V24	24V DC ±5%
+5V	...	0V5	5V DC ±5%

If any of the voltage measurements fails, replace the resolver interface board.

Figure 11 - Resolver Interface Board Testpoint Locations



Thermistors and Thermal Switches

Motor overheating is detected by an external, user-supplied themistor (PTC) or thermal switch connected to terminals 78 and 79 on the control power terminal block on the lower, right corner of the pulse transformer circuit board. See Figure 25 on page 120 for terminal block location.

Motor overheating is typically identified by a "Motor Over Temp" fault (F16). See "Fault Descriptions" in Chapter 4 of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001 for details. See Figure 22 on page 117 for a circuit diagram.

- If a thermal switch is used, a 1 kΩresistor must be placed in series between the switch and either terminal 78 or 79.
- If neither a thermistor (PTC) or a thermal switch is installed, a 1 kΩ resistor must be connected between terminals 78 and 79.

The drive heatsink temperature is monitored by a bimetal thermostat connected directly to the heatsink. When the heatsink temperature is too high, a "Heatsink OvrTemp" fault (F8) occurs. See "Fault Descriptions" in Chapter 4 of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001 for details. See Figure 23 on page 118 for a circuit diagram.

During normal operation, 1.6V DC is present between terminal 78 and drive common. When an open circuit exists between terminals 78 and 79, 24V DC will be present at terminal 78 to drive common. If the 24V is missing, the pulse transformer board may need replacement.

Relay Outputs

Terminals 35 and 36 and 75 and 76 are N.O. relay outputs. The relay output between terminals 35 and 36 is configured with parameter 1392 [Relay Out 1 Sel]. The relay output between terminals 75 and 76 is configured with parameter 629 [Relay Out 2 Sel]. See "Using Contactors" in Chapter 1 of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001, for more information.

The "Main Contactor" fault (F10) indicates a problems related to a contactor used with the drive. See "Fault Descriptions" in Chapter 4 of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001 for details.

Create a Fault Report

Complete fault reports are critical for analysis and repair of modules returned to the factory

At a minimum, perform and record the following:

- Record the contents of the fault queue (faults and times of occurrence). Refer to the PowerFlex Digital DC Drive User Manual, publication 20P-UM001, for detailed Fault and Alarm codes and descriptions.
- Make a record of any burn marks on the printed circuit boards, cabling, bus bars, and SCR modules
- Make a record of any liquid and condensation marks on the printed circuit boards, components and mechanical parts
- Make a record of the amount of dust and other additional particles on the drive and drive components
- Make a record of any mechanical damage to the drive and drive components
- Record the size and type of main fuses
- Record any other important marks and damage

What You Need When You Call Tech Support

When you contact Technical Support, please be prepared to provide the following information:

- Order number
- Product catalog number and drives series number (if applicable)
- Product serial number
- Firmware revision level
- Most recent fault code
- Your application

You can use the table below to record the data provided in each PowerFlex DC drive parameter listed.

Param(s)	Name	Description	Parameter Data
1349	Status1 at Fault	Captures and displays Par 381 [Drive Status 1] bit pattern at the time of the last fault.	
1350	Status2 at Fault	Captures and displays Par 382 [Drive Status 2] bit pattern at the time of the last fault.	
1351-1360	Fault x Code	A code that represents the fault that tripped the drive. The codes will appear in these parameters in the order they occur (i.e., [Fault 1 Code] = the most recent fault).	
1361-1370	Fault x Time	The time between initial drive power up and the occurrence of the associated trip fault.	
1371	Fault Arm Amps	Captures and displays the armature current (as a percentage of rated current) at the time of the last fault.	
1372	Fault Speed	Captures and displays the output speed (rpm) of the drive at the time of the last fault.	
1373	Fault Field Amps	Captures and displays the field current (as a percentage of rated current) at the time of the last fault.	
1374	Fault Voltage	Captures and displays the armature voltage at the time of the last fault.	

Access Procedures

Introduction

This chapter provides detailed procedures for removing and replacing drive components.

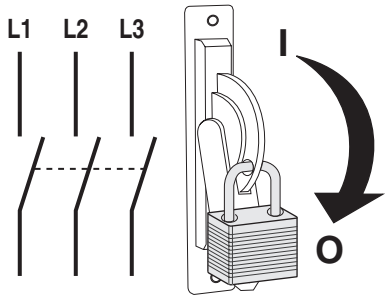
Remove Power from the Drive

ATTENTION: Remove power before making or breaking cable connections. When you remove or insert a cable connector with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine motion
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.

- Remove and lock-out all incoming power to the drive.



Switching Power Supply Fuse Removal and Installation

Remove the Fuse on the Switching Power Supply Circuit Board

IMPORTANT The fuse used for the switching power supply circuit board depends on the revision of the board.

- Fuse for switching power supply circuit board, SW1-31, rev. H & below - 5x20mm, 1A 250V Fuse.
- Fuse for switching power supply circuit board, SW1-31, rev. I & above - 5x20mm, 2.5A 250V Fuse.

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. On the top of the drive, remove the fuse by inserting a screwdriver in the slot on the top of the fuse holder, carefully pushing down and turning the fuse counterclockwise. When the fuse holder releases, remove the holder and fuse.

Top View of Drive

Install the Fuse on the Switching Power Supply Circuit Board

Install the fuse on the switching power supply board in reverse order of removal.

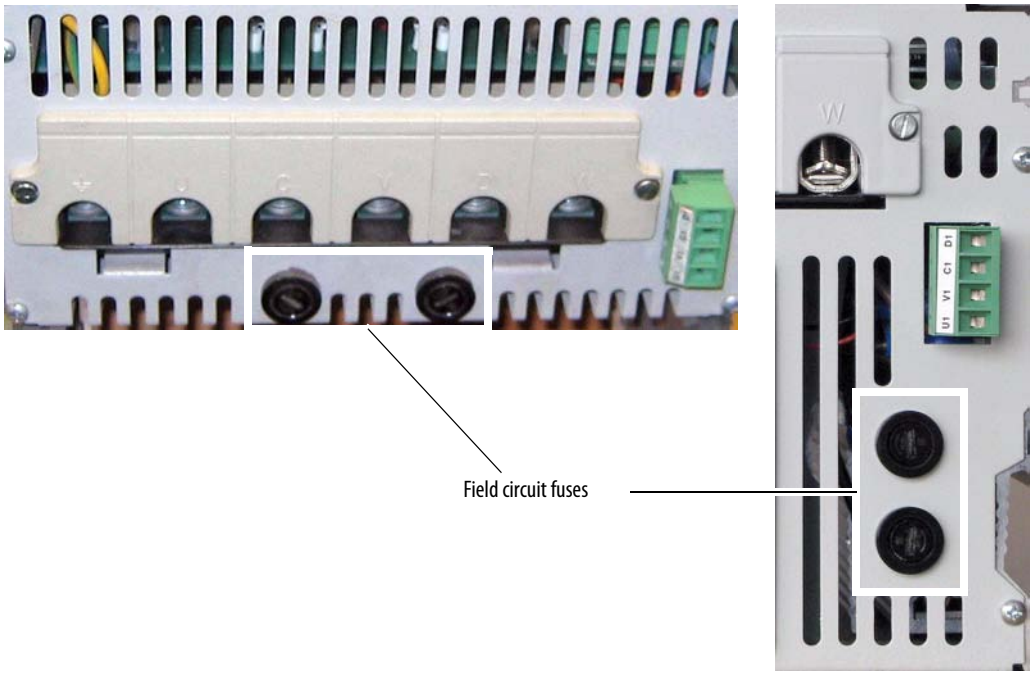
Field Circuit Fuse Removal and Installation

Remove the Field Circuit Fuses

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. On the bottom of the drive, remove a fuse by inserting a screwdriver in the slot on the top of the fuse holder, carefully pushing down and turning the fuse counterclockwise. When the fuse holder releases, remove the holder and fuse.

Bottom View of Drives

Drive with no Fan at Bottom **Drive with Fan at Bottom**



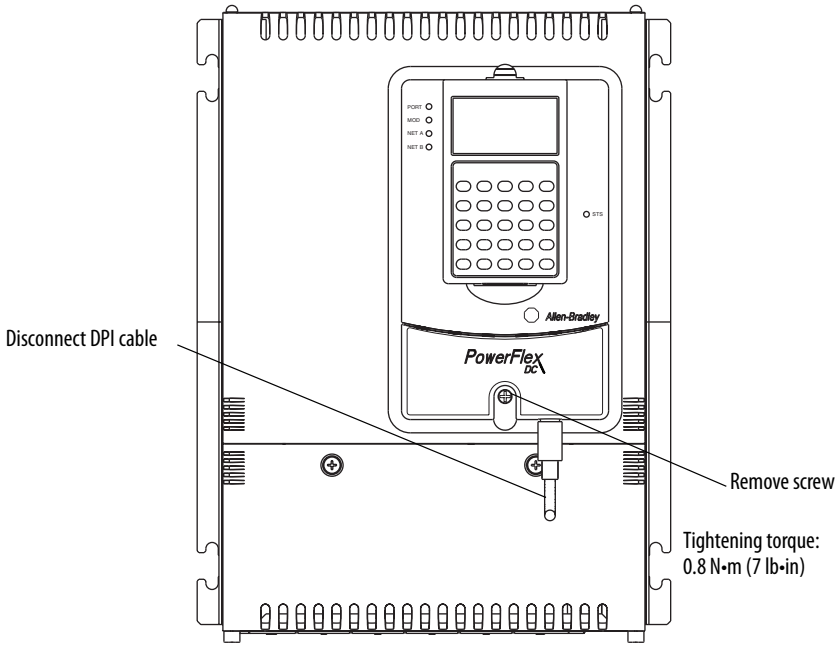
Install the Field Circuit Fuses

Install the field circuit fuses in reverse order of removal.

DPI / HIM Assembly Removal and Installation

Remove the DPI / HIM Assembly from the Protective Cover

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Disconnect the DPI cable from the HIM assembly.
4. Remove the screw that secures the DPI / HIM assembly to the drive.
5. Carefully remove the DPI / HIM assembly from the cover and disconnect the cable from the connector on the back side of the assembly.



Install the DPI / HIM Assembly on the Protective Cover

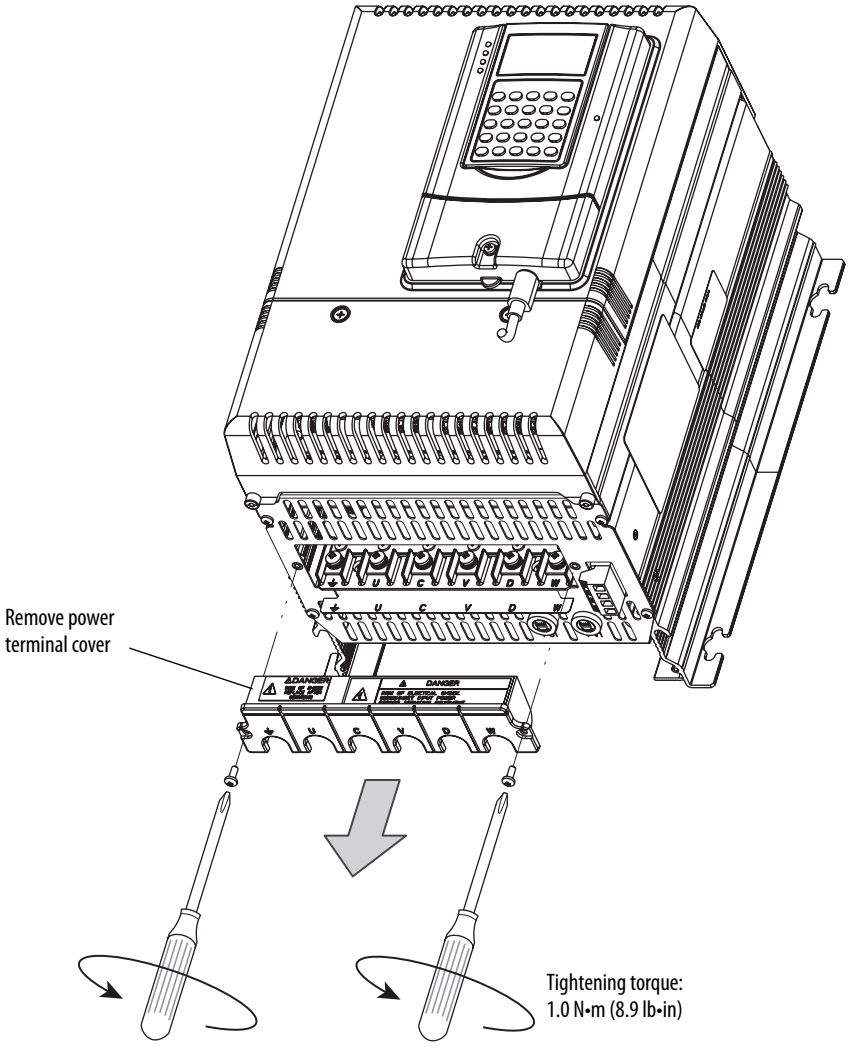
Install the DPI / HIM assembly in reverse order of removal.

Protective Cover Removal and Installation

Remove the Protective Covers

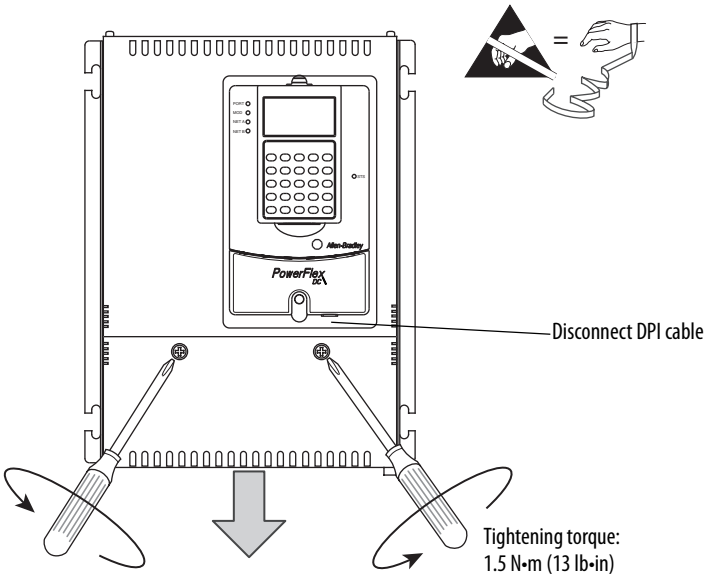
You must remove both the lower protective cover and the power terminal cover in order to access the power terminals.

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Loosen the two screws that secure the power terminal cover to the drive and slide the cover down and off the chassis.



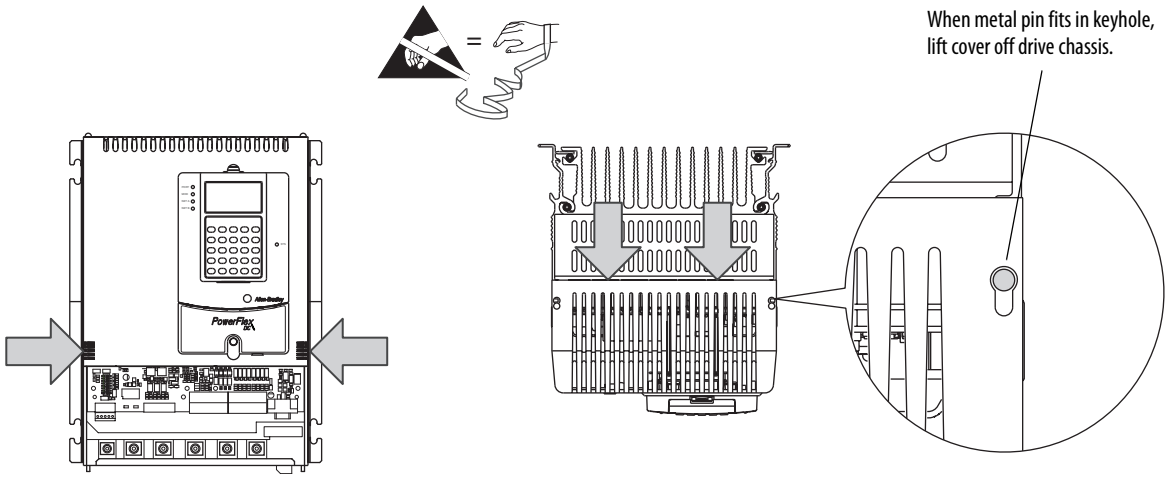
4. Disconnect the DPI cable from the HIM assembly.

5. Remove the two screws that secure the bottom protective cover to the drive and, while gently lifting along the top edge of the cover, slide it down and off the drive chassis.

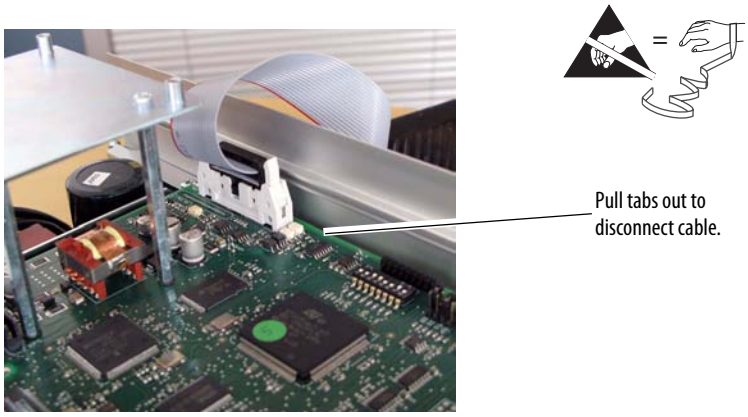


6. Press in on the sides at the bottom edge of the top cover and at the same time pull the cover toward you to pull it partially off the drive chassis. Next, at the top of the drive, pull the cover forward, away from the drive, until the pins fit in the keyhole in the top of the cover, then carefully lift the cover off of the drive chassis.

IMPORTANT The HIM assembly is connected via a cable to the control board and therefore will not pull free from the drive until disconnected. See step 7 below for instructions.



7. Disconnect the HIM communication cable from the connector on the upper right corner of the control board and set the cover aside.



Install the Protective Covers

Install the protective covers in reverse order of removal.

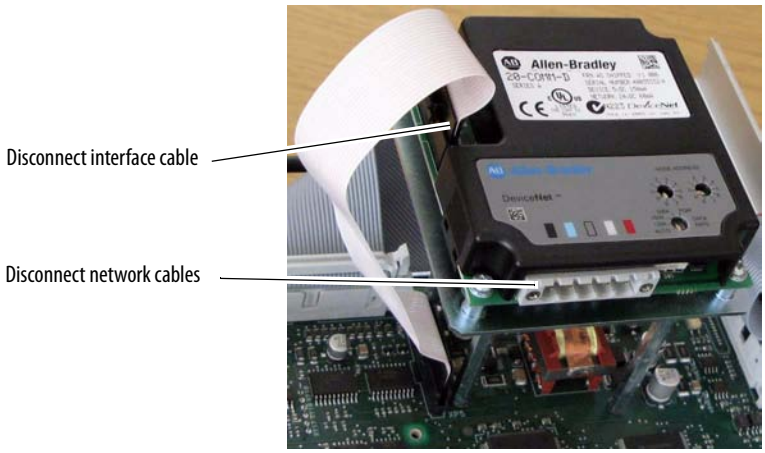
ATTENTION: Risk of electric shock exists when power is applied to the power terminals of the drive. The power terminal cover and protective covers must be replaced after servicing the drive.

Communication Adapter and EMI Shield Removal and Installation

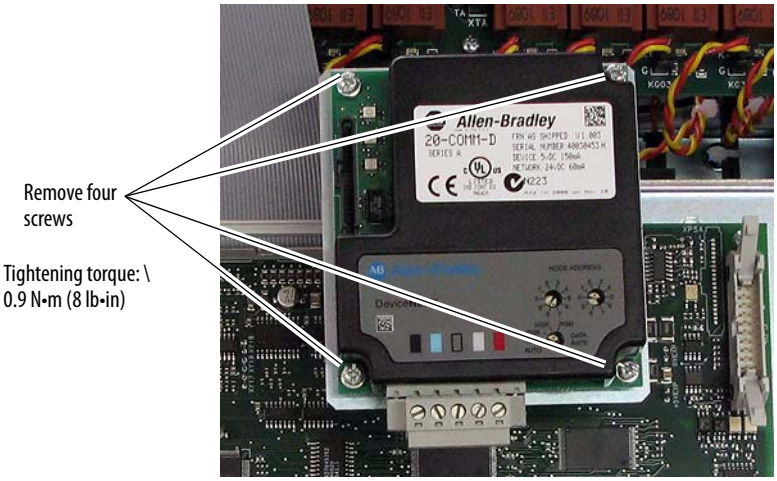
Remove the Communication Adapter and EMI Shield

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Disconnect the interface cable from the communication adapter and set it aside.

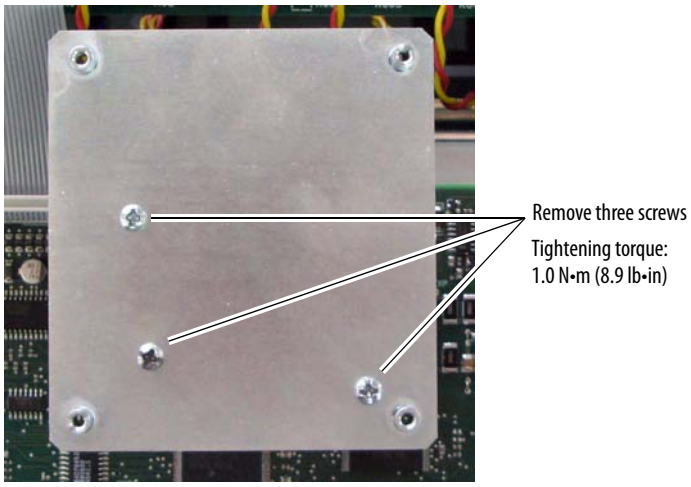
4. Disconnect any network cables from the adapter and set them aside.



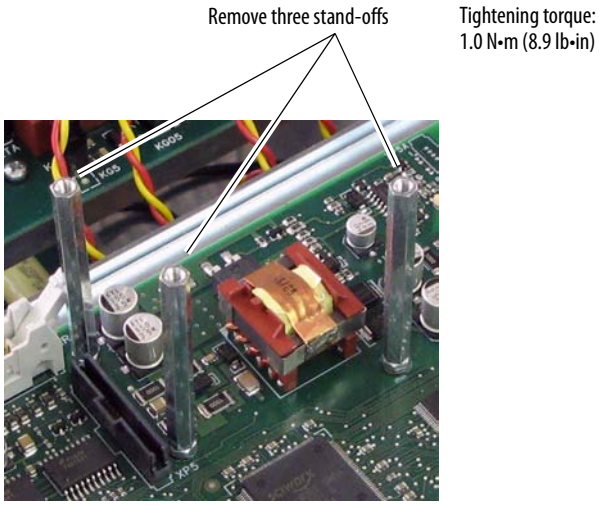
5. Remove the four screws that secure the communication adapter to the EMI shield and remove the adapter.



6. Remove the three screws that secure the EMI shield to the stand-offs on the control board and remove the EMI shield.



7. Remove the three stand-offs from the control board.



Install the Communication Adapter and EMI Shield

Install the communication adapter and EMI shield in reverse order of removal.

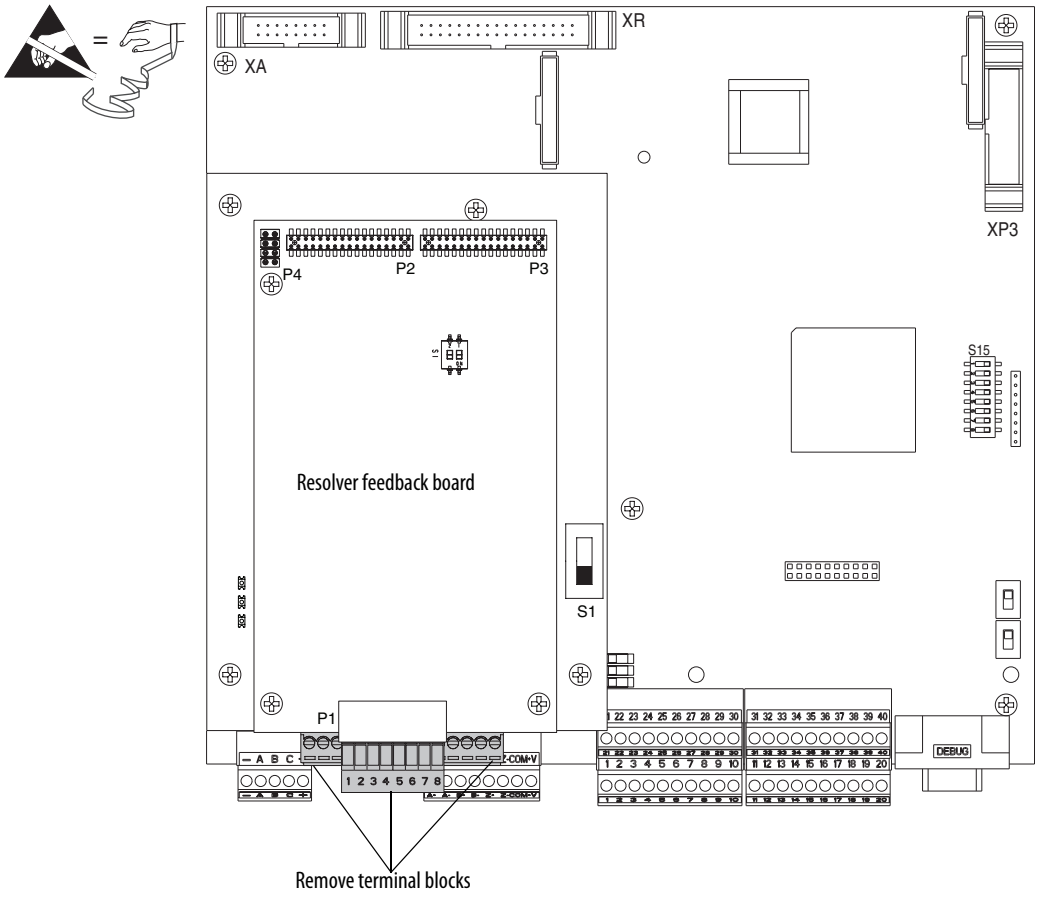
Resolver Feedback and Interface Circuit Board Removal and Installation

Remove the Resolver Feedback and Interface Circuit Boards

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Remove the protective covers (see Protective Cover Removal and Installation on page 48).

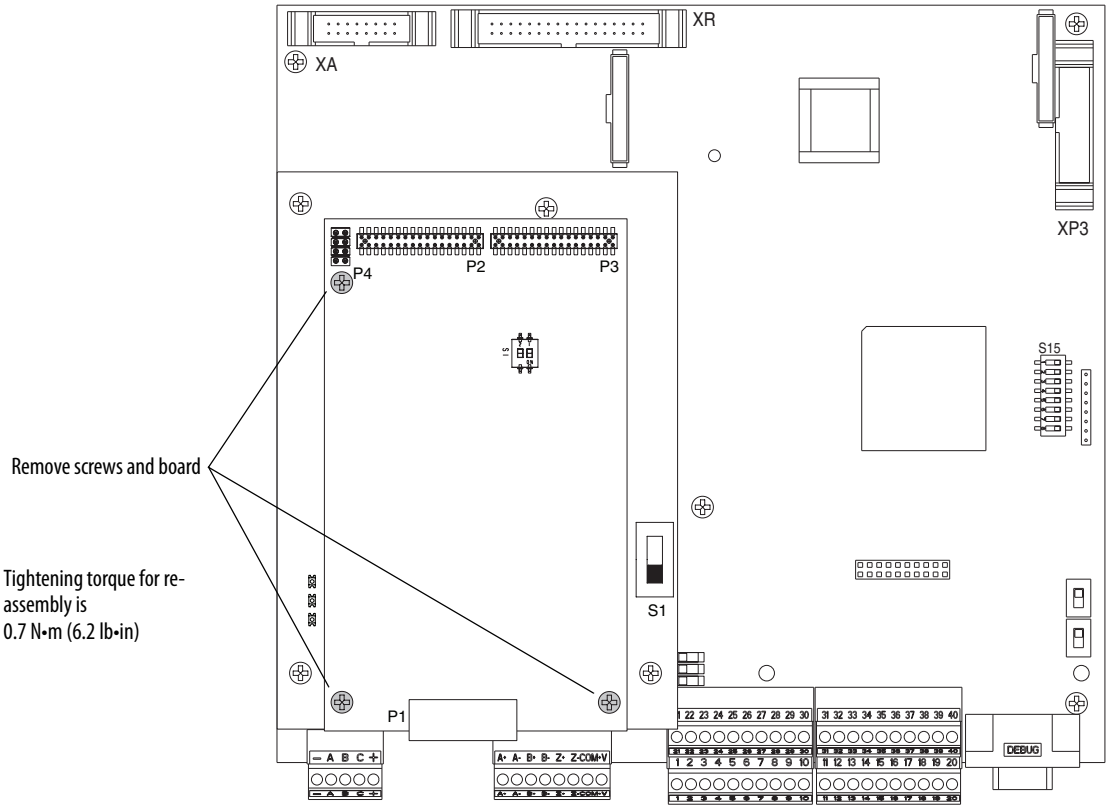
IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

4. Disconnect the plug-in terminal blocks from the resolver feedback and resolver interface boards.

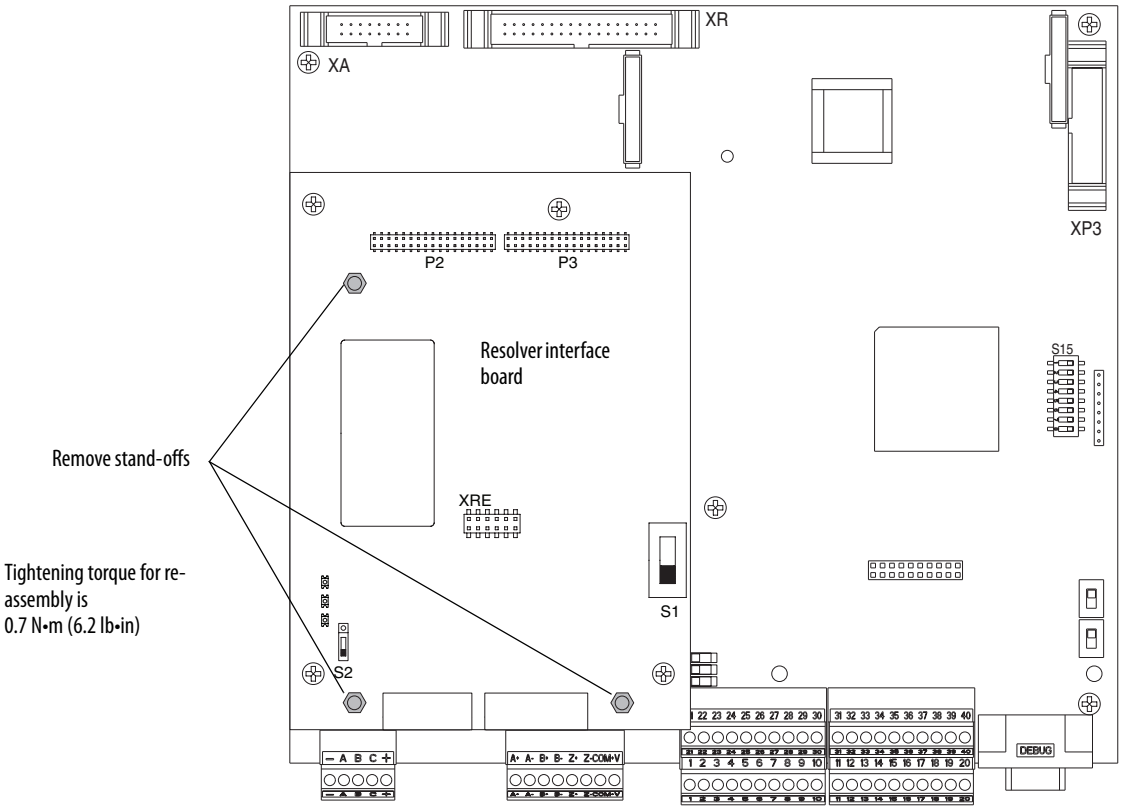


5. Remove the three hexalobular screws that secure the resolver feedback board to the stand-offs on the resolver interface board and carefully remove the resolver feedback board.

IMPORTANT The resolver feedback board is connected to the resolver interface board below it via stacker connector pins at connectors P2 and P3. Lift the resolver feedback board straight up during removal to avoid any damage to the connector pins.

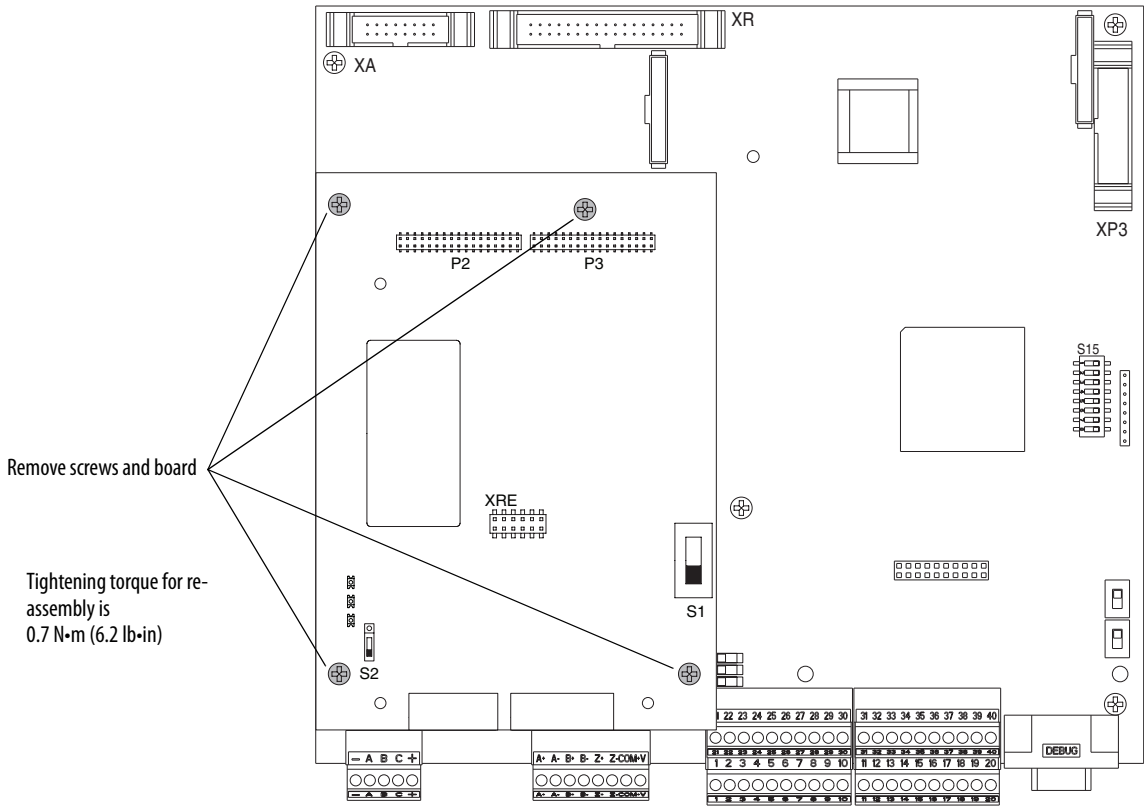


6. Remove the three stand-offs from the resolver interface board.



7. Remove the four hexalobular screws that secure the resolver interface board to the control board and remove the resolver interface board.

IMPORTANT The resolver interface board is connected to the control board below it via a stacker connector pin at connector XRE. Lift the resolver interface board straight up during removal to avoid any damage to the connector pin.



Install the Resolver Feedback and Interface Circuit Boards

Install the resolver feedback and interface boards in reverse order of removal.

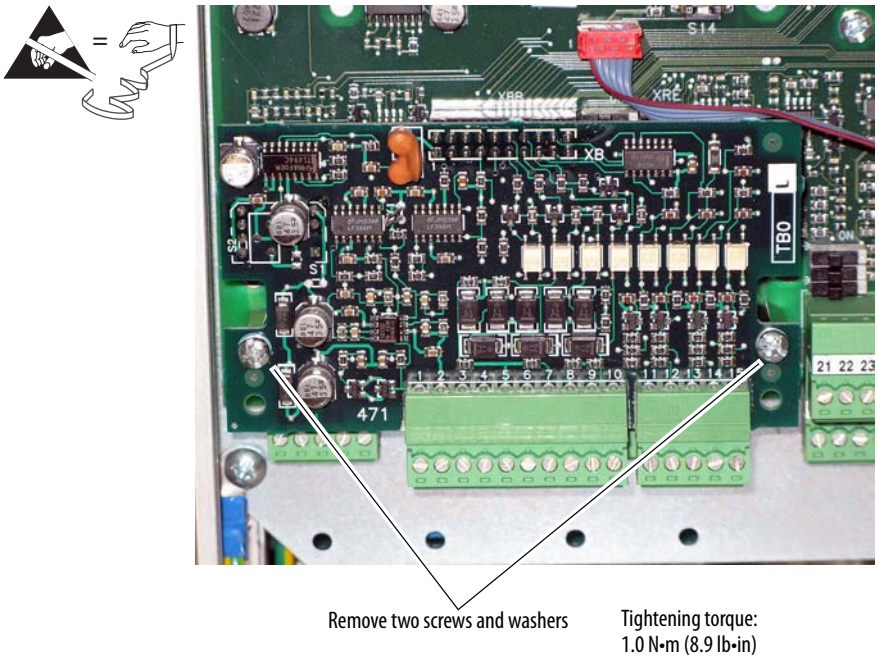
I/O Expansion Circuit Board Removal and Installation

Remove the I/O Expansion Circuit Board

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Remove the protective covers (see Protective Cover Removal and Installation on page 48).
4. If installed, remove the resolver feedback option and interface boards. See Resolver Feedback and Interface Circuit Board Removal and Installation on page 53.

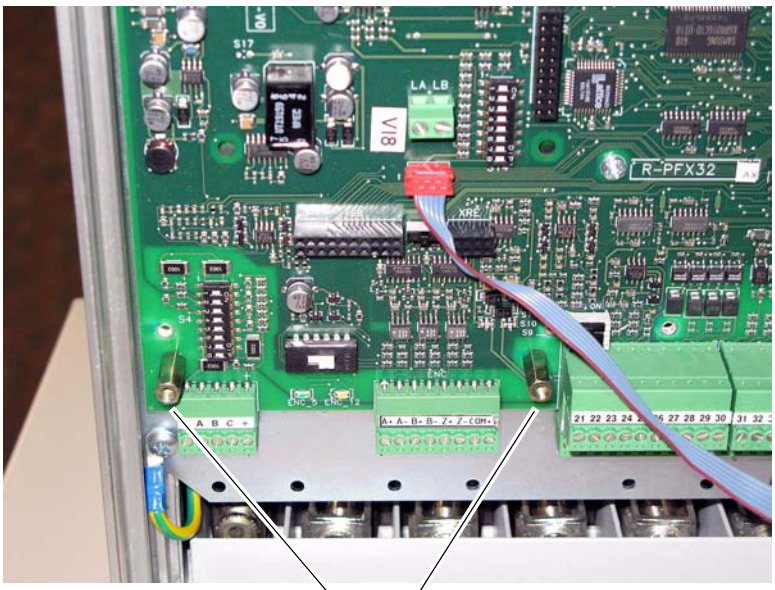
IMPORTANT	Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

5. Remove the plug-in I/O terminal blocks with the wiring kept in place.
6. Remove the two M3 x 6 mm screws and washers that secure the I/O expansion board to the stand-offs on the control board.

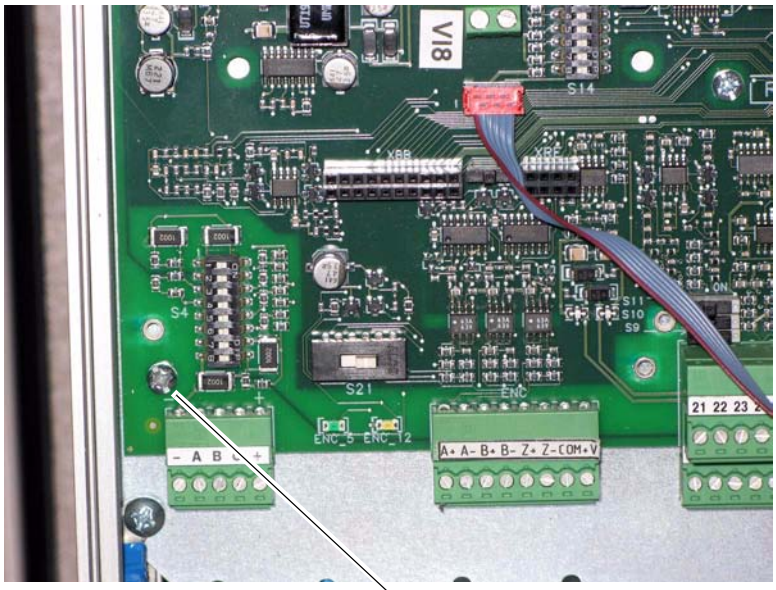


7. Carefully pull the I/O expansion board off connector XBB on the control board.

8. Remove the two stand-offs from the control board.



9. Install one of the existing screws in the lower left corner of the control circuit board.



Install the I/O Expansion Circuit Board

Install the I/O expansion board in reverse order of removal.

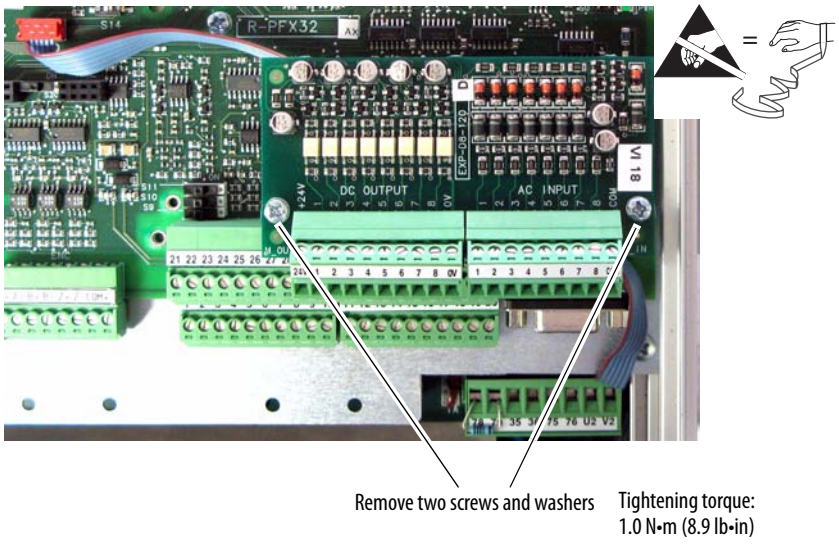
115V AC to 24V DC I/O Converter Circuit Board Removal and Installation

Remove the 115V AC to 24V DC I/O Converter Circuit Board

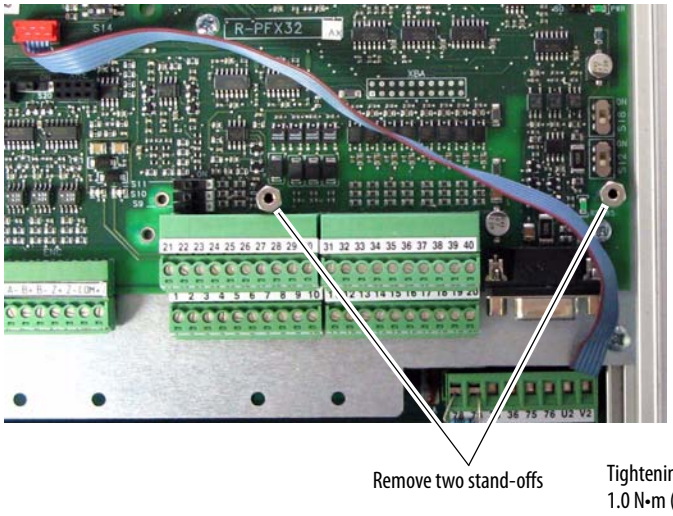
1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Remove the protective covers (see Protective Cover Removal and Installation on page 48).

IMPORTANT	Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

4. Remove the plug-in I/O terminal blocks with the wiring kept in place.
5. Remove the two M3 x 6 mm screws and washers that secure the I/O converter board to the stand-offs on the control board and remove the I/O converter board.



6. Remove the two stand-offs from the control board.



Install the 115V AC to 24V DC I/O Converter Circuit Board

Install the 115V AC to 24V DC I/O converter board in reverse order of removal.

Control Circuit Board Removal and Installation

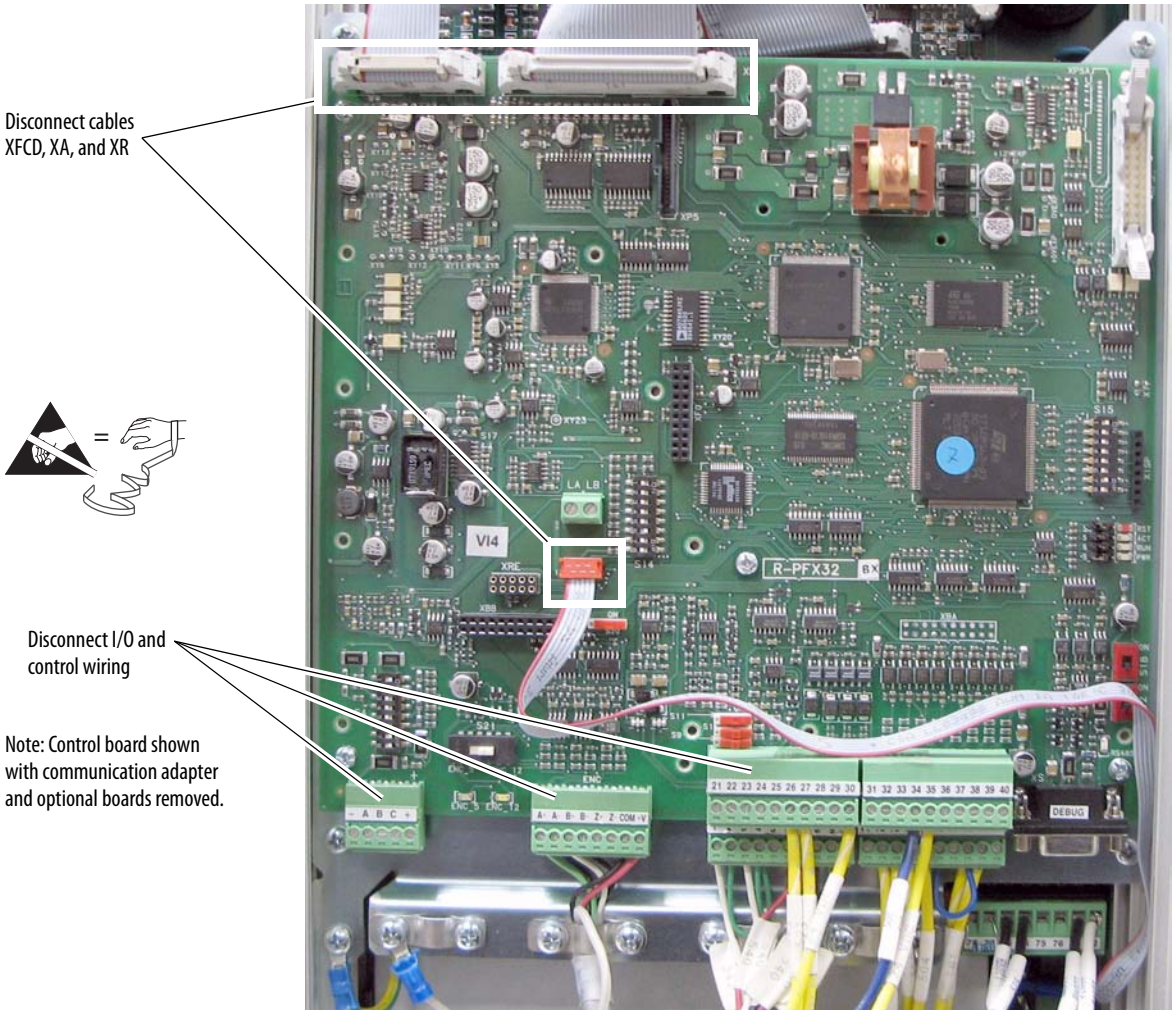
Remove the Control Circuit Board

1. Save the drive and adapter parameter configuration to a HIM Set or by down loading the drive and adapter parameters to an offline database file using DriveExecutive™. See the PowerFlex DC Digital Drive User Manual, publication 20P-UM001, for information on using the HIM or the on-line Help provided with DriveExecutive for more information on HIM Sets or using the HIM.
2. Read the General Safety Precautions on page 12.
3. Remove power from the drive (see Remove Power from the Drive on page 44).
4. Remove the protective covers (see Protective Cover Removal and Installation on page 48).
5. Remove the communication adapter and EMI shield from the control board (see Communication Adapter and EMI Shield Removal and Installation on page 50).
6. If installed, remove the I/O expansion circuit board (see I/O Expansion Circuit Board Removal and Installation on page 57).
7. If installed, remove the 115V AC to 24V DC I/O converter circuit board (see 115V AC to 24V DC I/O Converter Circuit Board Removal and Installation on page 59).

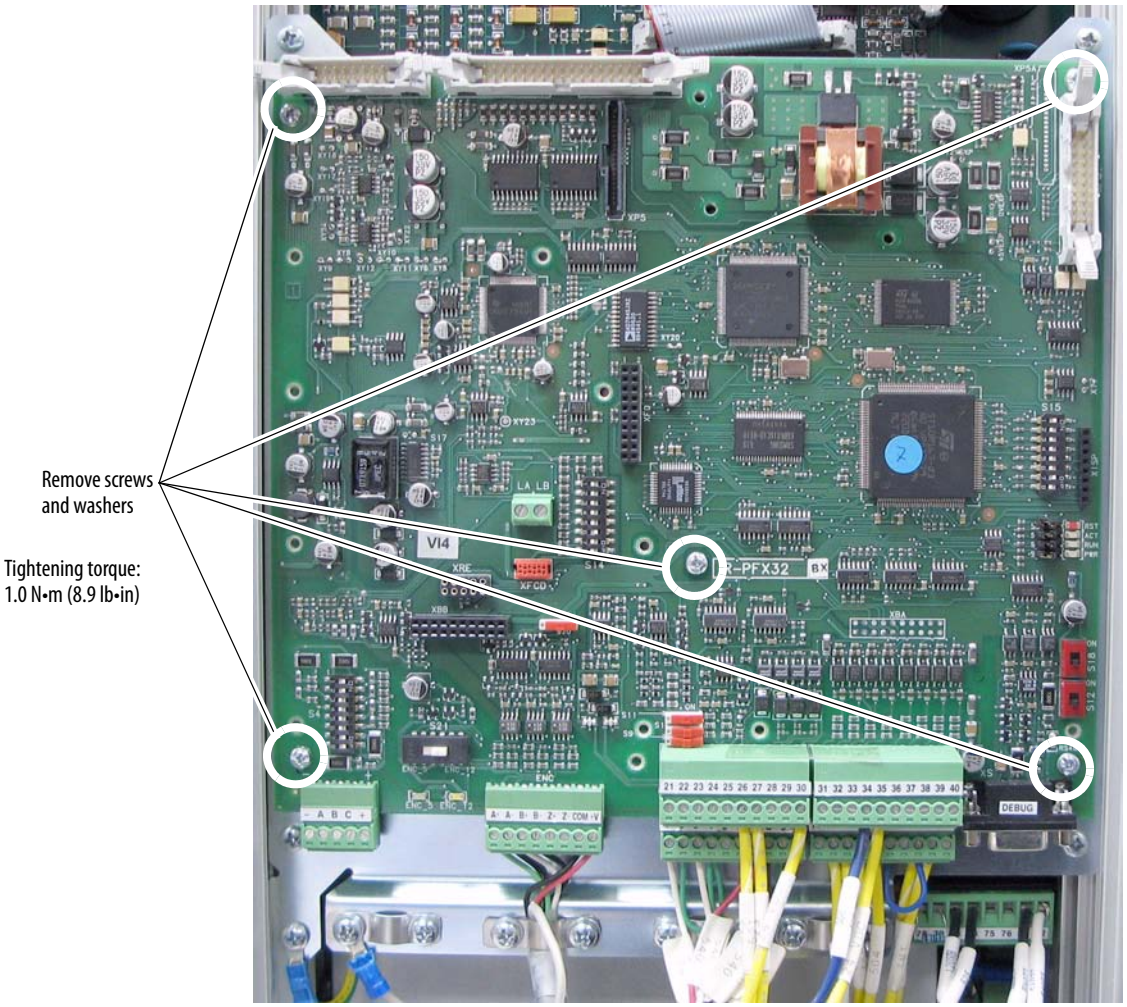
8. Record all switch and jumper settings on the control board. See the PowerFlex DC Digital Drive User Manual, publication 20P-UM001, for more information.

Jumper/ Switch	Function		Setting
S4	Configures the input voltage of the DC analog tachometer.		
S9	Configures the input signal of analog input 1 (terminals 1 and 2):		
	Note: The input signal type must also be programmed accordingly using Par 71 [Anlg In1 Config].		
S10	Configures the input signal of analog input 2 (terminal 3 and 4):		
	Note: The input signal type must also be programmed accordingly using Par 76 [Anlg In2 Config].		
S11	Configures the input signal of analog input 3 (terminals 5 and 6):		
	Note: The input signal type must also be programmed accordingly using Par 81 [Anlg In3 Config].		
S14	Field current resistors setting. In addition, the value selected with switch S14 must be entered in Par 374 [Rated Field Curr] in the control software when the drive is commissioned.		S14-1 = S14-2 = S14-3 = S14-4 = S14-5 = S14-6 =
S15	Configuration of the control circuit board to the appropriate drive size. This value is set to the appropriate size at the factory.		S15-1 = S15-2 = S15-3 = S15-4 = S15-5 = S15-6 = S15-7 = S15-8 =
S20	Monitoring of the Z channel of the digital encoder on connector XE2:		
	Off Position	Z-channel monitored	
	On Position	Z-channel not monitored	
S21	Encoder power supply voltage and input adaptation selection: Note: When control power is supplied to the drive, the appropriate LED lights to indicate the selection of the switch.		
	ENC_5	+5 V encoder (+2.5…5.4V input range)	
	ENC_12	+12…15 V encoder (+5.4V…15.2V input range)	

9. Carefully disconnect the cables from connectors XFCD, XA and XR on the control board.
10. Remove the plug-in I/O and control terminal blocks with the wiring kept in place.



11. Remove the five M3 x 6 mm screws and washers that secure the control board to the control EMI shield and remove the control board.



Install the Control Circuit Board

Install the control board in reverse order of removal.

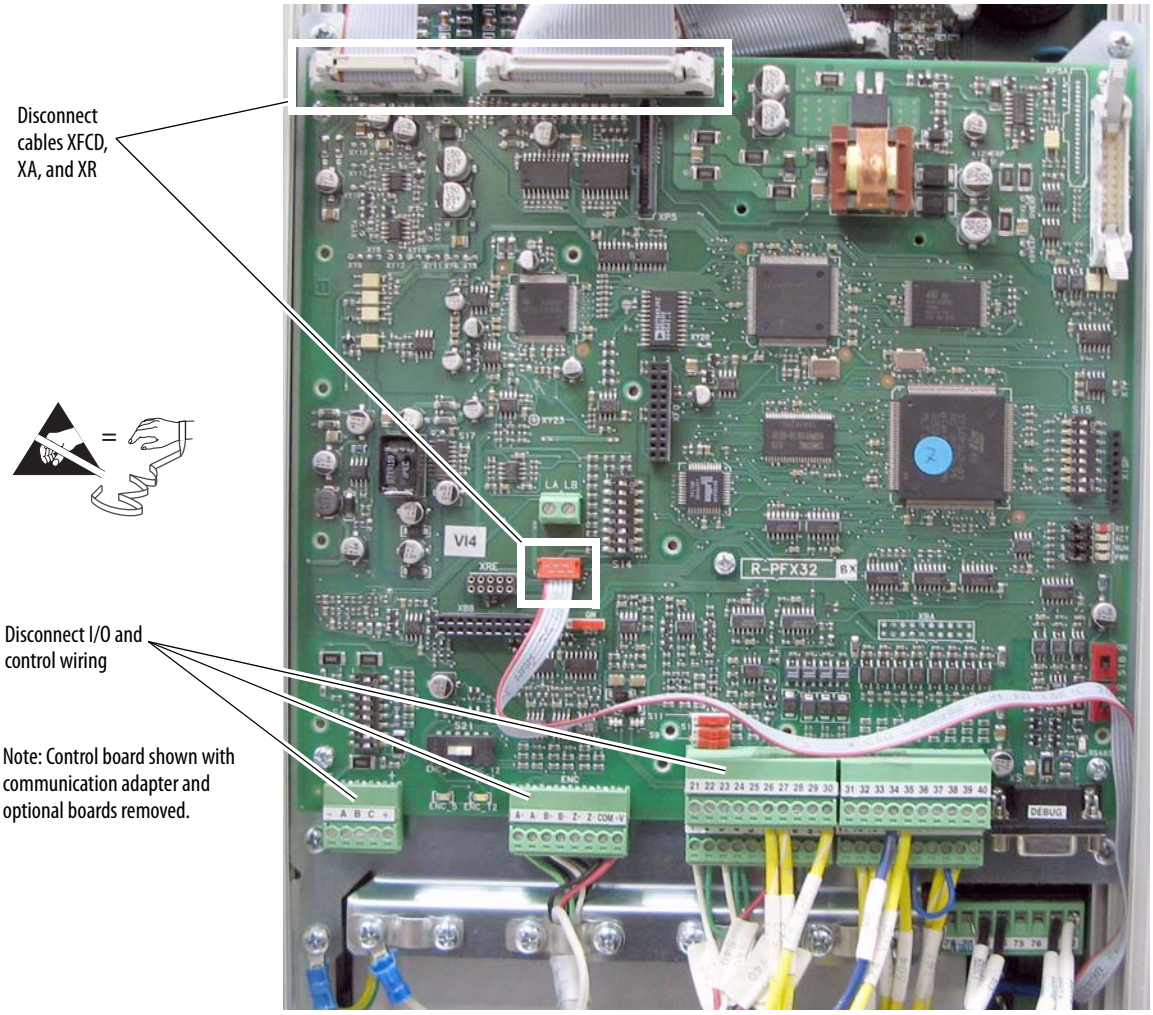
- Verify that all DIP switches are set to the correct configuration based on your recorded settings. See page 61.

Control EMI Shield and Control Circuit Board Removal and Installation

Remove the Control EMI Shield and Control Circuit Board

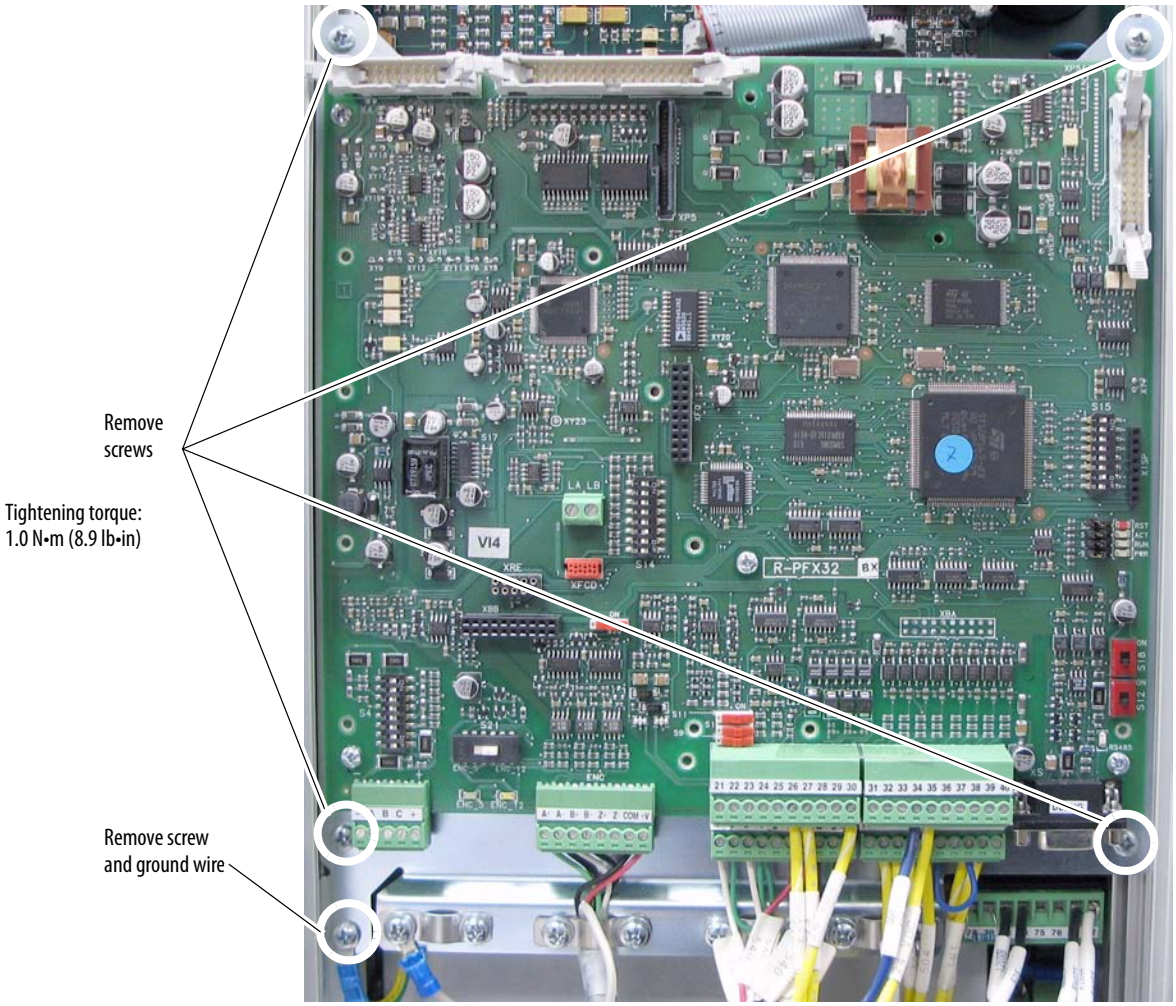
You must remove the control EMI shield that holds the control board in order to access other components within the drive.

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Remove the protective covers (see Protective Cover Removal and Installation on page 48).
4. Carefully disconnect the cables from connectors XFCD, XA and XR on the control board.
5. Remove the plug-in I/O, analog tachometer and encoder terminal blocks with the wiring kept in place (if used).



6. Remove the five M4 x 9.5 mm screws that secure the control EMI shield and ground wire (in the lower left corner) to the chassis and slide the control EMI shield and control board up and out of the drive.

IMPORTANT	Be careful when removing the EMI shield not to pull free any of the gate leads or other cables on the pulse transformer circuit board below the EMI shield.



Install the Control EMI Shield and Control Circuit Board

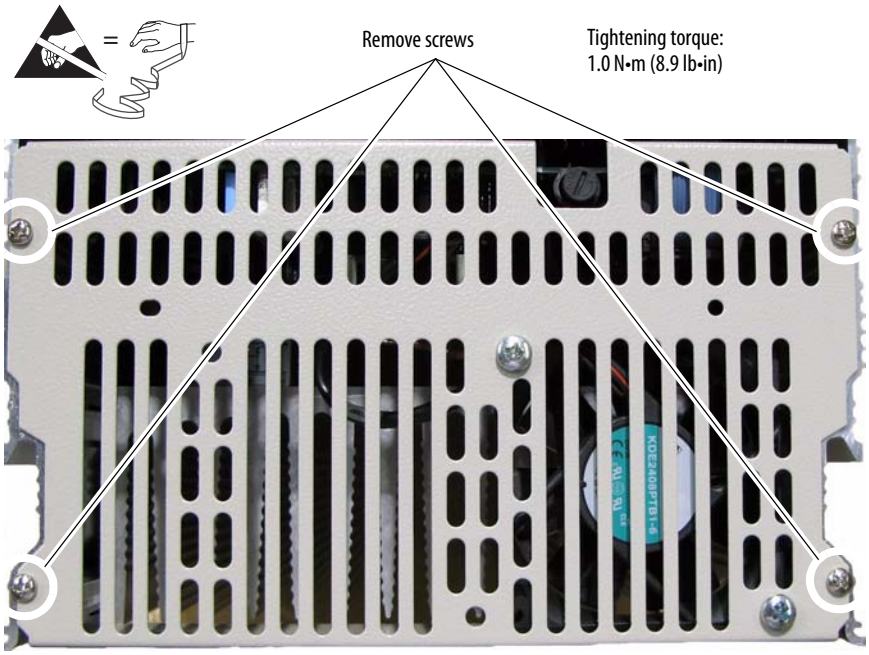
Install the control EMI shield and control board in reverse order of removal.

Pulse Transformer and Switching Power Supply Circuit Board Removal and Installation

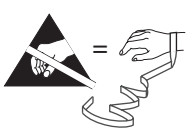
Remove the Pulse Transformer and Switching Power Supply Circuit Board

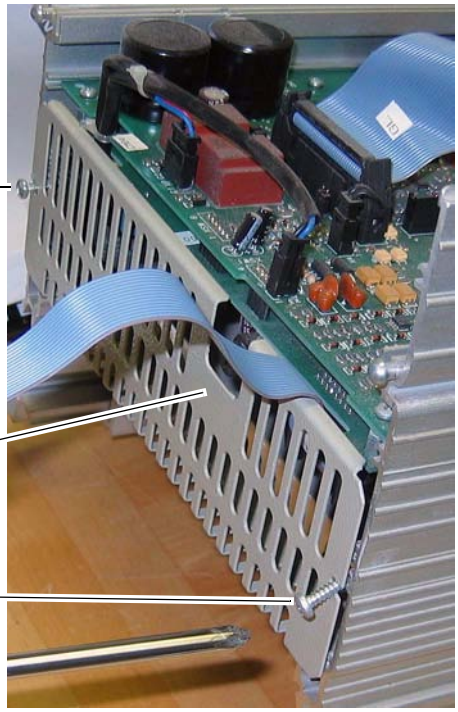
Note: The switching power supply circuit board is located on the back of the pulse transformer circuit board. You must remove both boards in order to replace either board.

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Remove the protective covers (see Protective Cover Removal and Installation on page 48).
4. Remove the control EMI shield and control board (see Control EMI Shield and Control Circuit Board Removal and Installation on page 64).
5. Remove the slotted air flow plate from the top of the drive.
   - For 38A/10 HP and 55A/15 HP drives with 230V AC input and 35A/20 HP, 45A/25 HP, and 52A/30 HP drives with 460V AC input, remove the four screws that secure the slotted air flow plate to the top of the drive, remove the fan cable from connector XV on the switching power supply board and remove the plate.



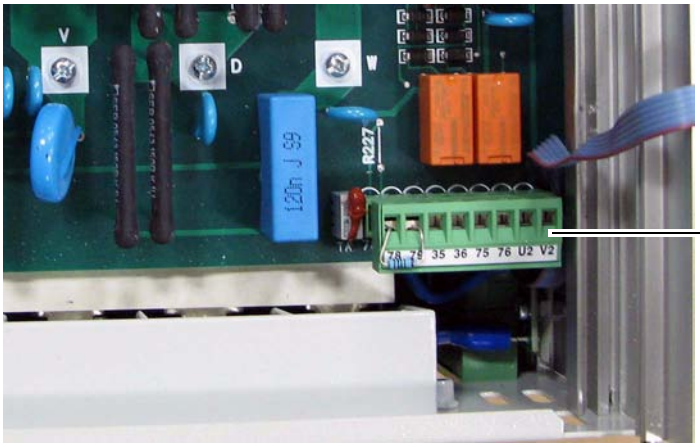
- For all other drives, remove the two screws that secure the slotted air flow plate to the top of the drive and remove the plate.





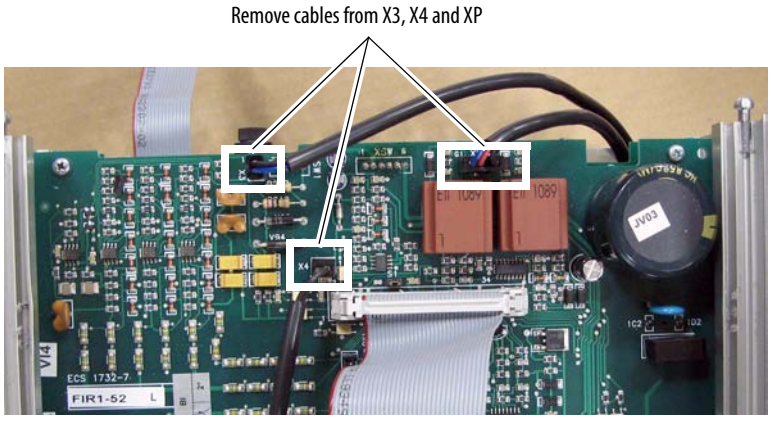
IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

6. Remove the plug-in control power terminal block from the lower right corner of the pulse transformer circuit board.

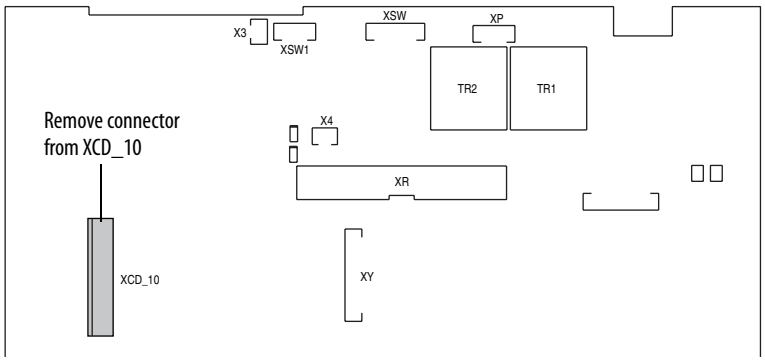


7. Remove the cables from connectors X3, X4 and XP at the top of the pulse transformer board.

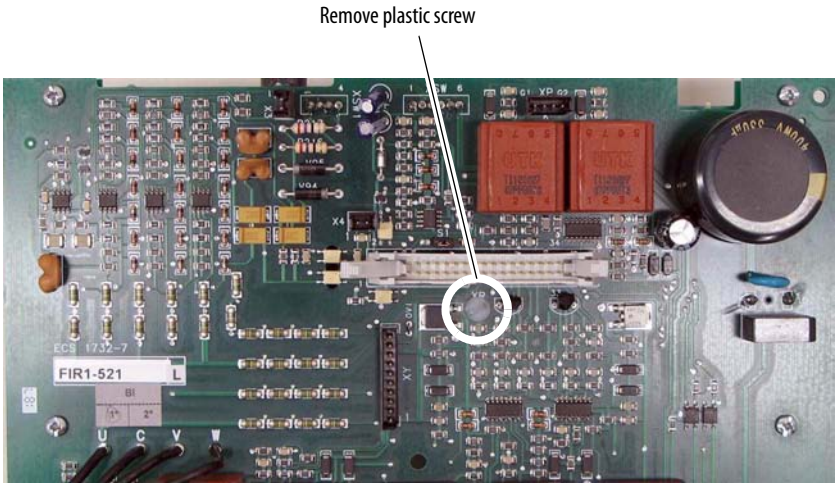
   Note: Connector X4 contains a jumper for drives without a fan - leave in place.



8. For pulse transformer boards with an armature voltage feedback terminal block, FIR1-XX, rev "Q" and higher, remove the connector from XCD_10 on the upper left corner of the board.



9. Remove the plastic screw near the top of the pulse transformer board and retain for reuse.

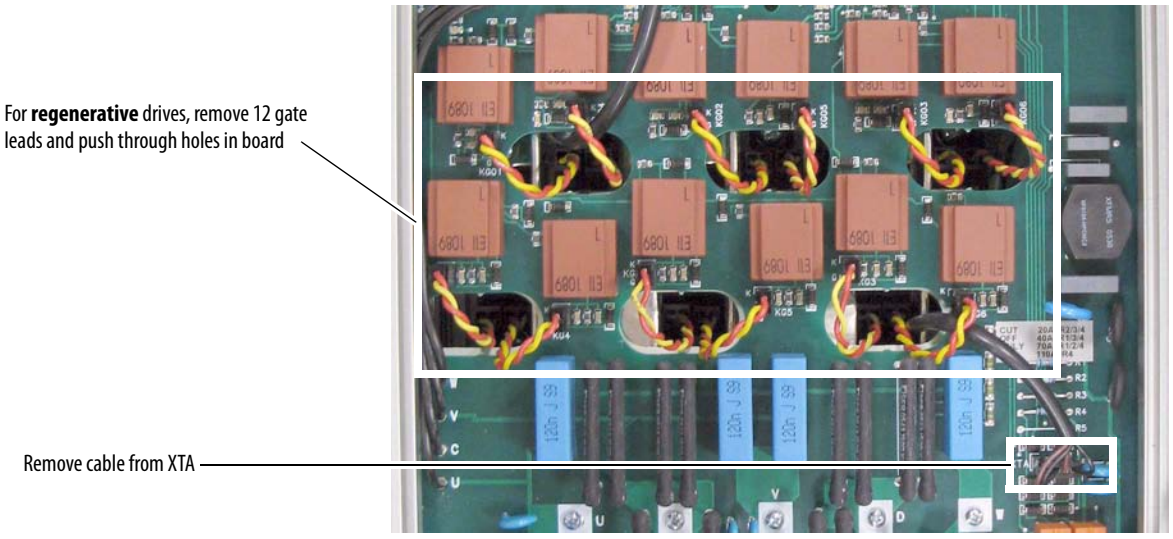


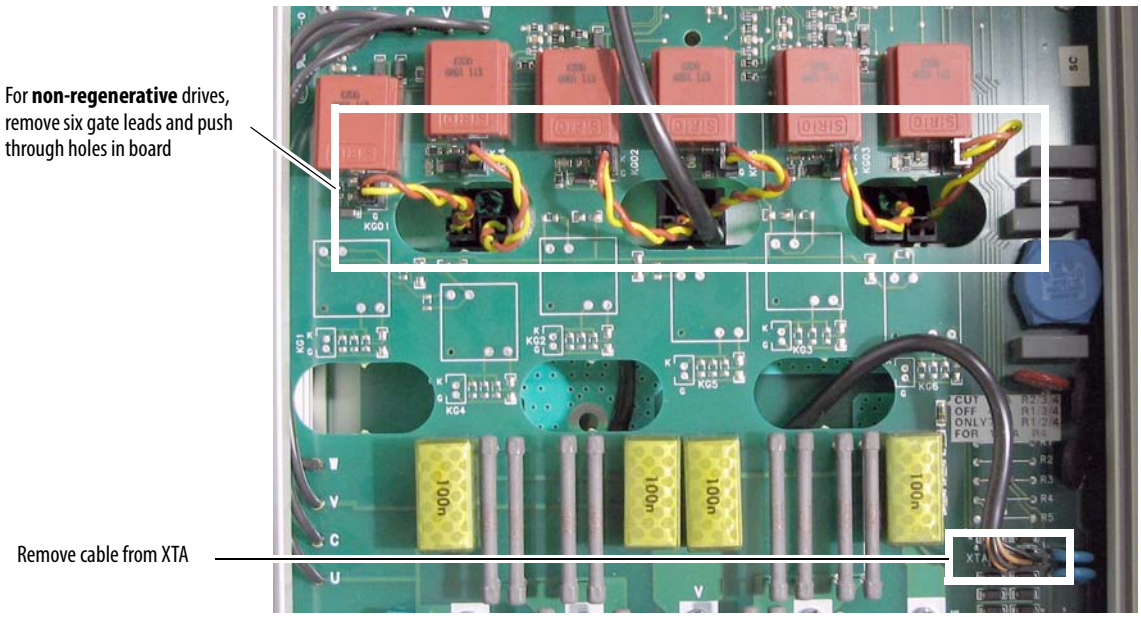
10. Remove the appropriate gate leads:

- For regenerative drives, remove each pair of (orange and yellow) gate lead cables from connectors KG01...KG06 and KG1...KG6 and push each lead through the appropriate opening in the board.
- For non-regenerative drives, remove each pair of (orange and yellow) gate lead cables from connectors KG01...KG06 and push each lead through the appropriate opening in the board.

IMPORTANT Carefully remove the gate leads by grasping the connector. DO NOT pull the gate leads off by pulling on the wires.

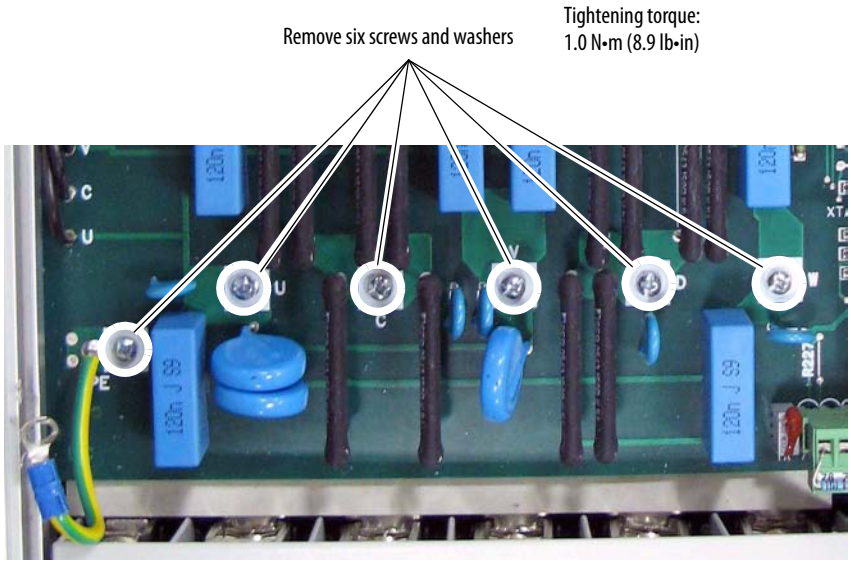
11. Remove the cable from connectors XTA on the lower right side of the board.

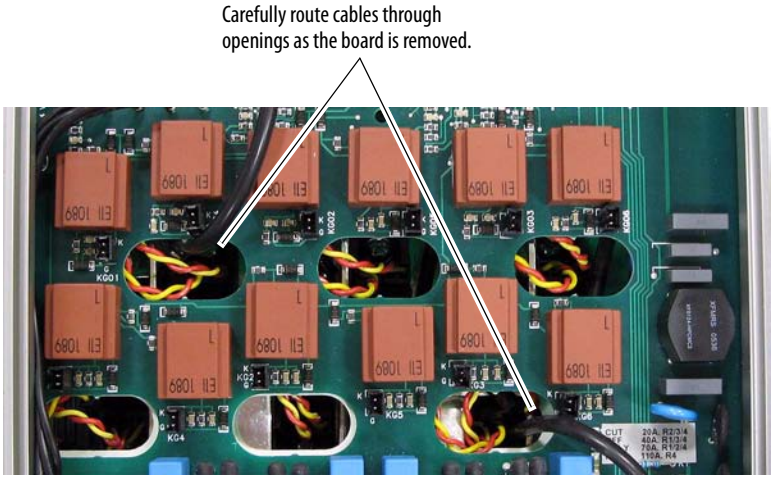




12. Remove the six M3 x 6 mm screws and washers that secure the bottom of the pulse transformer board to the drive and, while lifting up slightly on the board, slide it toward the top of the drive and out of the chassis. Note that there is an isolation sheet below the board; do not remove this sheet unless it is damaged.

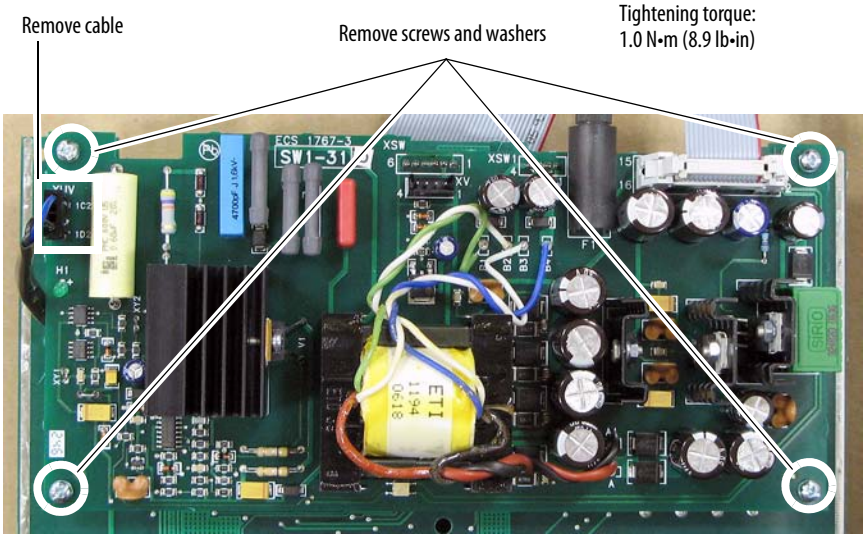
IMPORTANT	The cables from connectors X4 and XTA must slide through the openings in the board as it is lifted out of the drive chassis. Take care not to damage these cables and connectors.



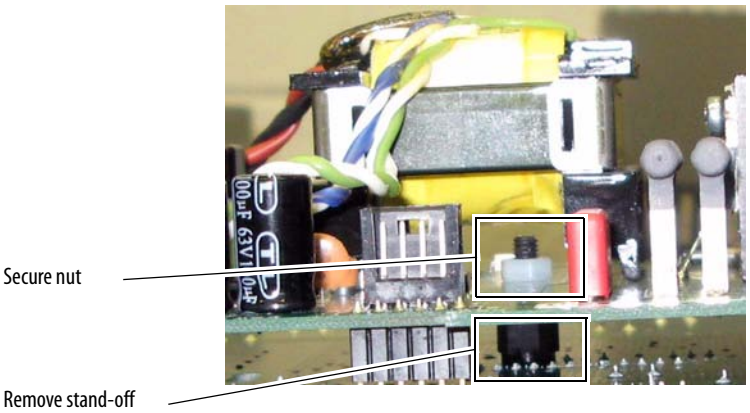


Regenerative drive shown

13. Remove the cable from connector XUV on the left side of the switching power supply board.
14. Remove the four M3 x 6 mm screws and washers that secure the switching power supply board to the stand-offs on the back of the pulse transformer board and remove the switching power supply board.



15. Remove the plastic stand-off and nut that secures the switching power supply board to the back of the pulse transformer board.



Install the Pulse Transformer and Switching Power Supply Circuit Boards

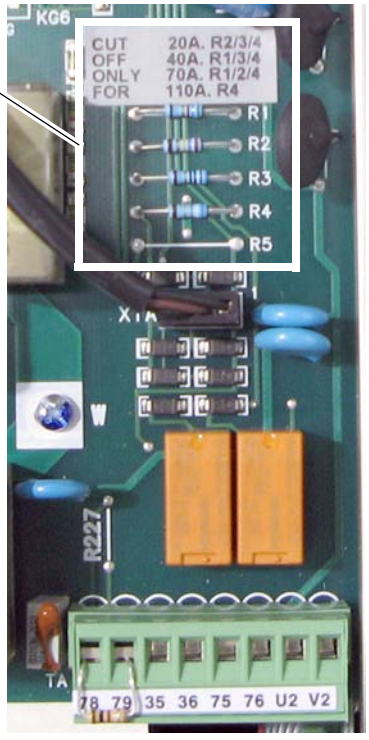
The pulse transformer circuit board must be configured to match the drive size (armature output current and HP rating). The steps required to complete the configuration are different based on the revision code of the board. See either, Configuring the Pulse Transformer Board FIR1-XX Rev. "P" and Lower below, or Configure a Pulse Transformer Board FIR1-XX Rev. "Q" and Higher on page 76.

Configuring the Pulse Transformer Board FIR1-XX Rev. "P" and Lower

IMPORTANT This procedure requires a multimeter that measures resistance to thousandths of an ohm.

1. Cut and remove the appropriate sizing resistor(s) (if necessary) from the pulse transformer board based on the drive size. See Table 12 or Table 13 in the Sizing Resistor Configuration section on page 73 for the appropriate configuration.

Sizing resistors are located on the lower right corner of the pulse transformer circuit board.



Sizing Resistor Configuration

Table 12 and Table 13 below indicate the value of the designated resistor (R1...R5) when left in place on the pulse transformer board, or indicate "Remove" when the resistor should be cut off and removed from the board. "–" indicates that this resistor is not contained on the pulse transformer board for the designated drive size.

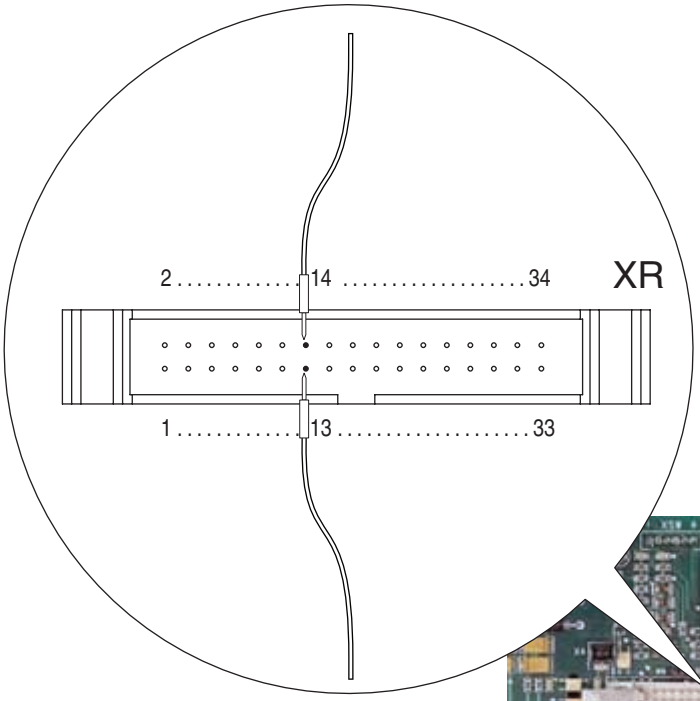
Table 12 - 230V AC Input Drives

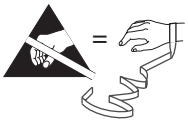
Drive Current Rating Code	DC Amps	AC Line Amps	HP	R1	R2	R3	R4	R5
7P0	7	5.7	1.5	Remove	27.4Ω	Remove	Remove	–
9P0	9	7.4	2	Remove	Remove	39.2Ω	Remove	–
012	12	9.8	3	Remove	27.4Ω	Remove	Remove	–
020	20	16	5	56.2Ω	Remove	Remove	Remove	–
029	29	24	7.5	Remove	Remove	39.2Ω	Remove	–
038	38	31	10	Remove	27.4Ω	Remove	Remove	–
055	55	45	15	56.2Ω	27.4Ω	Remove	Remove	–
073	73	60	20	Remove	27.4Ω	39.2Ω	Remove	–
093	93	76	25	Remove	Remove	Remove	6.98Ω	–
110	110	90	30	Remove	Remove	Remove	6.98Ω	–

Table 13 - 460V AC Input Drives

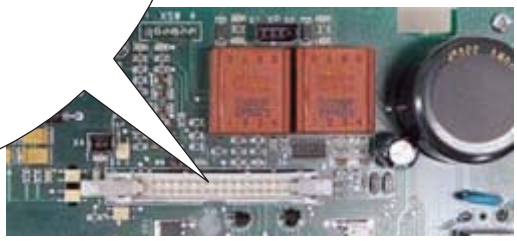
Drive Current Rating Code	DC Amps	AC Line Amps	HP	R1	R2	R3	R4	R5
4P1	4.1	3.3	2	56.2Ω	Remove	Remove	Remove	–
6P0	6	4.9	3	Remove	Remove	39.2Ω	Remove	–
010	10	8.2	5	Remove	Remove	39.2Ω	Remove	–
014	14	11.4	7.5	Remove	27.4Ω	Remove	Remove	–
019	19	15.5	10	56.2Ω	Remove	Remove	Remove	–
027	27	22.1	15	Remove	Remove	39.2Ω	Remove	–
035	35	28.6	20	Remove	27.4Ω	Remove	Remove	–
045	45	36.8	25	56.2Ω	Remove	39.2Ω	Remove	–
052	52	42.5	30	56.2Ω	27.4Ω	Remove	Remove	–
073	73	59.6	40	Remove	27.4Ω	39.2Ω	Remove	–
086	86	70.3	50	Remove	Remove	Remove	6.98Ω	–
100	100	81.7	60	Remove	Remove	Remove	6.98Ω	–
129	129	105.4	75	Remove	Remove	Remove	6.98Ω	–

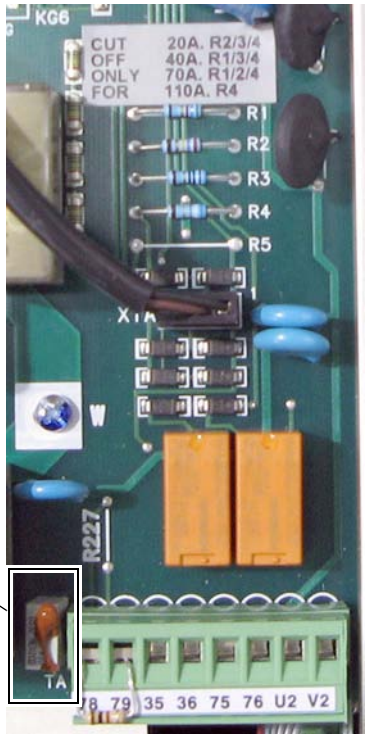
2. Connect the leads of the multimeter to pins 13 and 14 of connector XR on the pulse transformer board (polarity is not important) and, using the TA potentiometer on the lower right corner of the pulse transformer circuit board, set the total resistance (RTA) to the appropriate value as indicated in Table 14 or Table 15 in the Total Resistance Values section on page 75.





The XR connector is located on the upper right corner of the pulse transformer circuit board.





The TA potentiometer is located on the lower right corner of the pulse transformer circuit board next to the control power terminal block. Shown sealed.

Total Resistance Values

Table 14 - 230V AC Input Drives

Drive Current Rating Code	DC Amps	AC Line Amps	HP	Set RTA Value Using TA Potentiometer (Ohms)
7P0	7	5.7	1.5	34.971
9P0	9	7.4	2	45.333
012	12	9.8	3	34
020	20	16	5	61.2
029	29	24	7.5	42.207
038	38	31	10	32.211
055	55	45	15	22.255
073	73	60	20	16.767
093	93	76	25	13.161
110	110	90	30	11.127

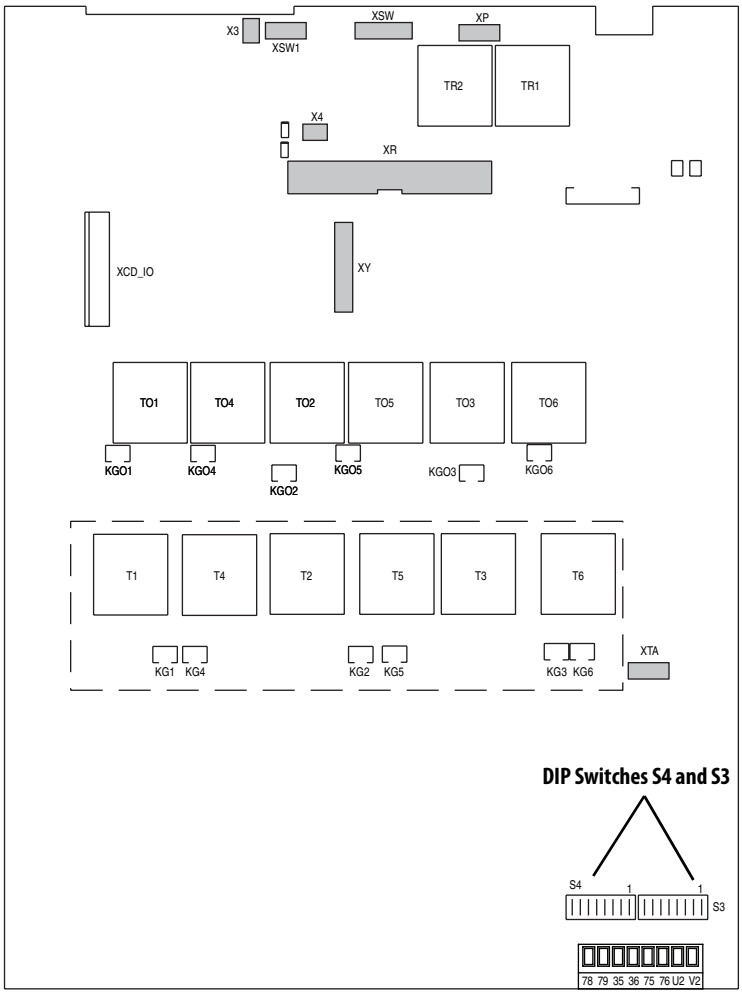
Table 15 - 460V AC Input Drives

Drive Current Rating Code	DC Amps	AC Line Amps	HP	Set RTA Value Using TA Potentiometer (Ohms)
4P1	4.1	3.3	2	59.707
6P0	6	4.9	3	40.8
010	10	8.2	5	40.8
014	14	11.4	7.5	29.143
019	19	15.5	10	64.421
027	27	22.1	15	45.333
035	35	28.6	20	34.971
045	45	36.8	25	27.2
052	52	42.5	30	23.538
073	73	59.6	40	16.767
086	86	70.3	50	14.233
100	100	81.7	60	12.24
129	129	105.4	75	9.488

3. Seal the TA potentiometer in place using RTV (silicon).
4. Continue with Install the Configured Pulse Transformer Circuit Board and the Switching Power Supply Circuit Board on page 77.

Configure a Pulse Transformer Board FIR1-XX Rev. "Q" and Higher

1. Set DIP switches S3 and S4, located on the pulse transformer board (see illustration below for location), to the correct settings based on the drive current rating. See 230V AC Input Drives on page 77 and 460V AC Input Drives on page 77.



IMPORTANT A blank cell below a switch in Table 16 and Table 17 below indicate that the setting is "OFF".

Table 16 - 230V AC Input Drives

Drive Current Rating Code	DC Amps	AC Line Amps	HP	DIP Switch S3								DIP Switch S4							
				S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	S3-7	S3-8	S4-1	S4-2	S4-3	S4-4	S4-5	S4-6	S4-7	S4-8
7P0	7	5.7	1.5					ON	ON		ON								
9P0	9	7.4	2		ON			ON	ON										
012	12	9.8	3		ON						ON	ON							
020	20	16	5	ON	ON		ON												
029	29	24	7.5		ON			ON		ON									
038	38	31	10		ON								ON						
055	55	45	15		ON	ON		ON					ON						
073	73	60	20							ON	ON	ON	ON						
093	93	76	25		ON			ON					ON		ON				
110	110	90	30				ON			ON					ON	ON			

Table 17 - 460V AC Input Drives

Drive Current Rating Code	DC Amps	AC Line Amps	HP	DIP Switch S3								DIP Switch S4							
				S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	S3-7	S3-8	S4-1	S4-2	S4-3	S4-4	S4-5	S4-6	S4-7	S4-8
4P1	4.1	3.3	2		ON	ON	ON												
6P0	6	4.9	3				ON	ON		ON									
010	10	8.2	5				ON	ON		ON									
014	14	11.4	7.5							ON	ON	ON							
019	19	15.5	10	ON	ON	ON													
027	27	22.1	15		ON			ON	ON										
035	35	28.6	20					ON	ON		ON								
045	45	36.8	25				ON	ON		ON	ON								
052	52	42.5	30					ON		ON	ON	ON							
073	73	59.6	40							ON	ON	ON	ON						
086	86	70.3	50					ON					ON		ON				
100	100	81.7	60					ON			ON		ON		ON				
129	129	105.4	75				ON						ON		ON	ON			

2. Continue with Install the Configured Pulse Transformer Circuit Board and the Switching Power Supply Circuit Board below.

Install the Configured Pulse Transformer Circuit Board and the Switching Power Supply Circuit Board

1. Install the Isolation sheet (if present) before installing the pulse transformer and switching power supply boards.

ATTENTION: Failure to install the Isolation sheet below the pulse transformer and switching power supply boards may result in damage to the drive.

2. Install the configured pulse transformer board and switching power supply board in reverse order of removal.

ATTENTION: Each gate lead cable must be connected to the exact connector from which it was removed on the pulse transformer circuit board or damage to the drive may occur. See Figure 15 on page 114 or Figure 16 on page 114 for gate lead pinouts.

AC Current Transducer Removal and Installation

Remove the AC Current Transducers

IMPORTANT AC current transducers must be replaced in pairs.

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Remove the protective covers (see Protective Cover Removal and Installation on page 48).
4. Remove the control EMI shield and control circuit board (see Control EMI Shield and Control Circuit Board Removal and Installation on page 64).
5. Remove the pulse transformer and switching power supply circuit boards (see Pulse Transformer and Switching Power Supply Circuit Board Removal and Installation on page 66).

   The drive rating determines the power bridge configuration and where the AC current transducers are located in the drive:

   - Frame A drives rated up to 55A/15 HP with 230V AC input or up to 52A/30 HP with 460V AC input have AC Current transducers installed on the power traces board. See AC Current Transducers on Drives with a Power Traces Board on page 79.

   OR

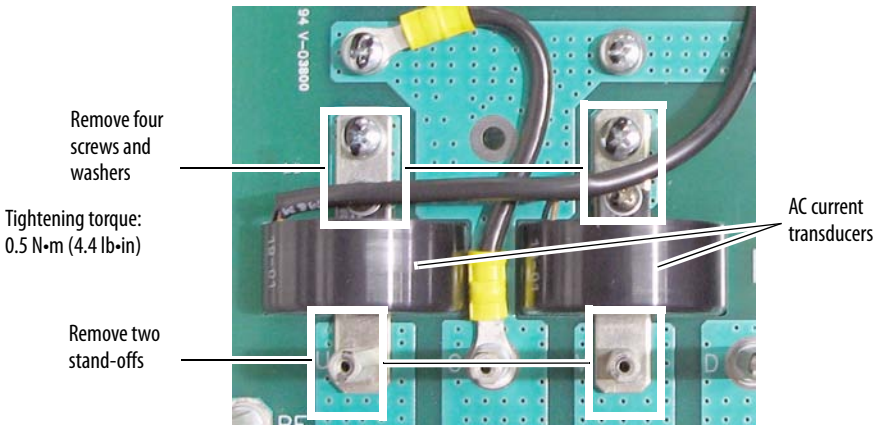
   - Frame A drives rated 73A/20 HP with 230V AC input and higher and 73A/40 HP with 460V AC input and higher have AC current transducers installed on the bus bars inside the drive. See AC Current Transducers from Drives Rated 73A/20 HP with 230V AC Input and Higher or 73A/40 HP with 460V AC Input and Higher on page 81.

AC Current Transducers on Drives with a Power Traces Board

The drive size determines how the AC current transducers are secured to the power traces board. See Remove the Current Transducers with Connection Bars on page 79 below for drives with a single metal bar and no windings on the AC current transducers. See Remove the Current Transducers with No Connection Bars on page 80 for drives no metal bar and windings on the AC current transducers.

Remove the Current Transducers with Connection Bars

6. Remove the four M3 x 6 mm screws and washers that secure the top of the AC current transducers to the power traces board.
7. Remove the two stand-offs that secure the bottom of the AC current transducers to the power traces circuit board and remove the AC current transducers from the drive. Continue with Install the AC Current Transducers on page 84.

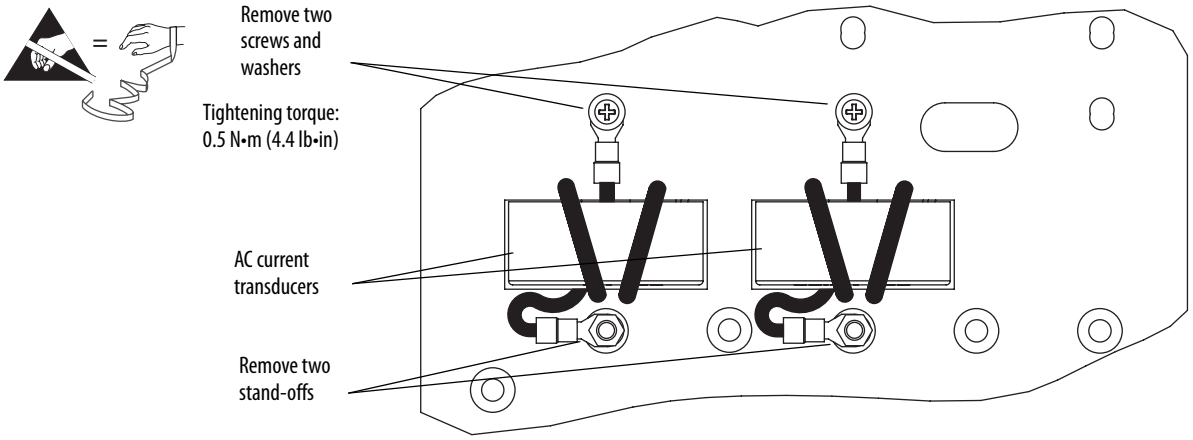


Note: non-regenerative drive shown

8. Continue with Install the AC Current Transducers on page 84.

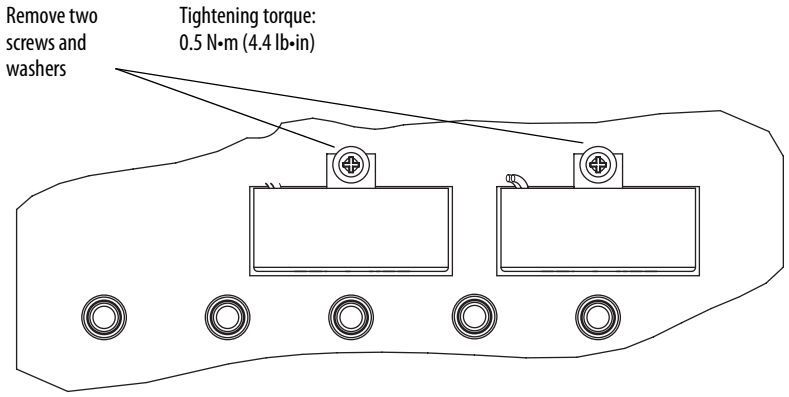
Remove the Current Transducers with No Connection Bars

6. Remove the four M3 x 6 mm screws and washers that secure the top of the AC current transducers to the power traces board.
7. Remove the two screws and washers that secure the top of the wire leads to the power traces board.



8. Turn the board over and remove the two M3 x 6 mm screws and washers that secure the AC current transducers to the board and remove the AC current transducers and windings (if present) from the drive.

IMPORTANT You do not need to remove the windings from the AC current transducers, however, note the number of times the wire lead is wound around the AC current transducers for proper installation of the new AC current transducers. Continue with Install the AC Current Transducers on page 84.

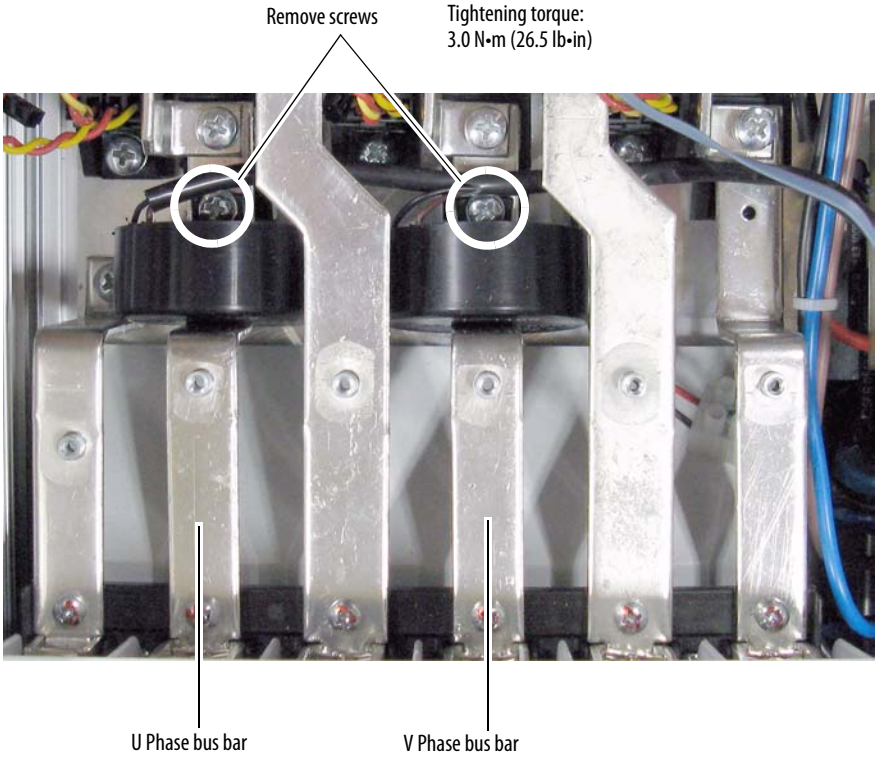


9. Continue with Install the AC Current Transducers on page 84.

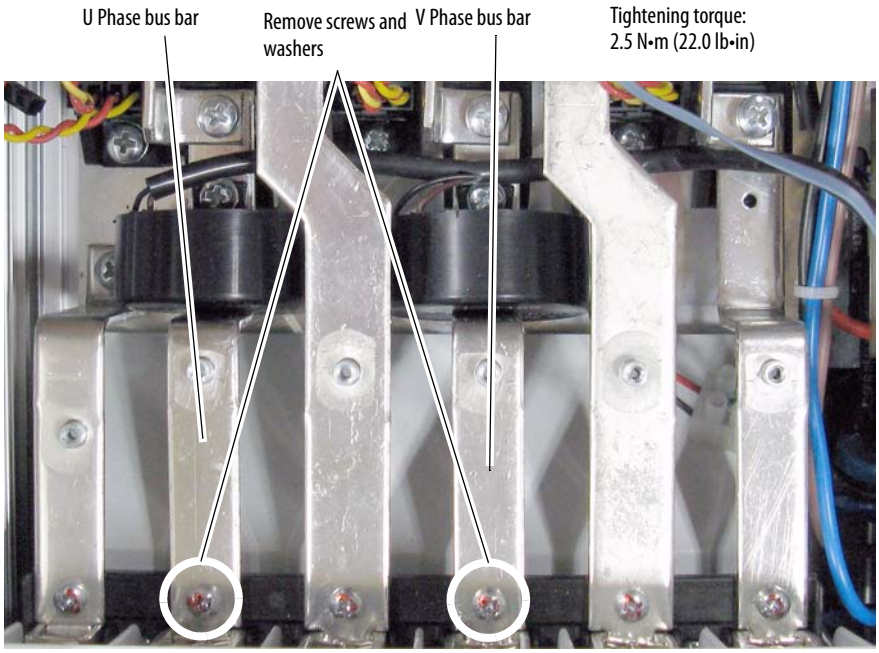
AC Current Transducers from Drives Rated 73A/20 HP with 230V AC Input and Higher or 73A/40 HP with 460V AC Input and Higher

IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

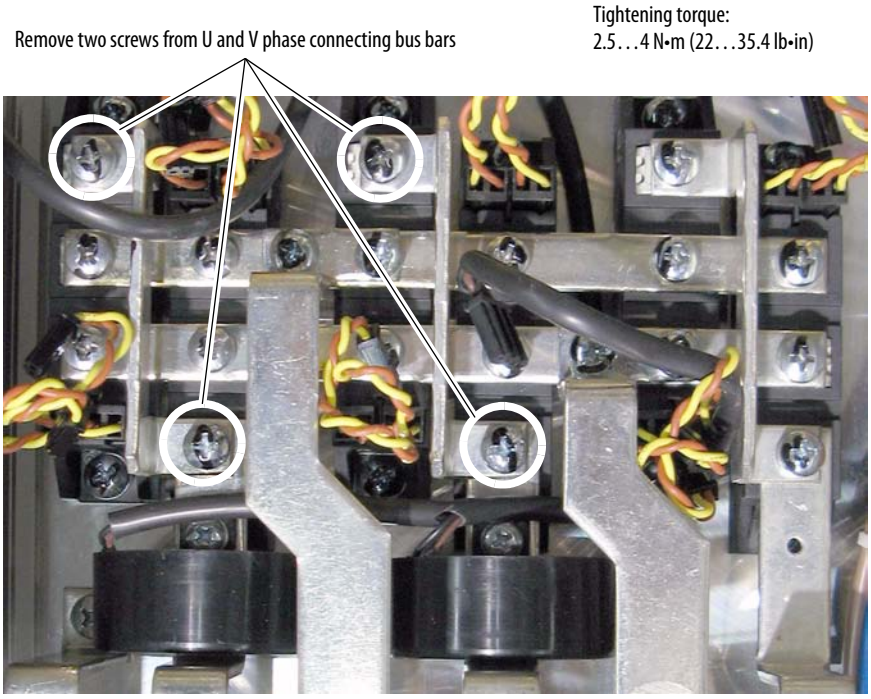
6. Remove the power connections from terminals U and V at the bottom of the drive.
7. Remove the M4 x12.5 mm screws and washers that secure each of the AC current transducers to the U and V Phase terminal bus bars.



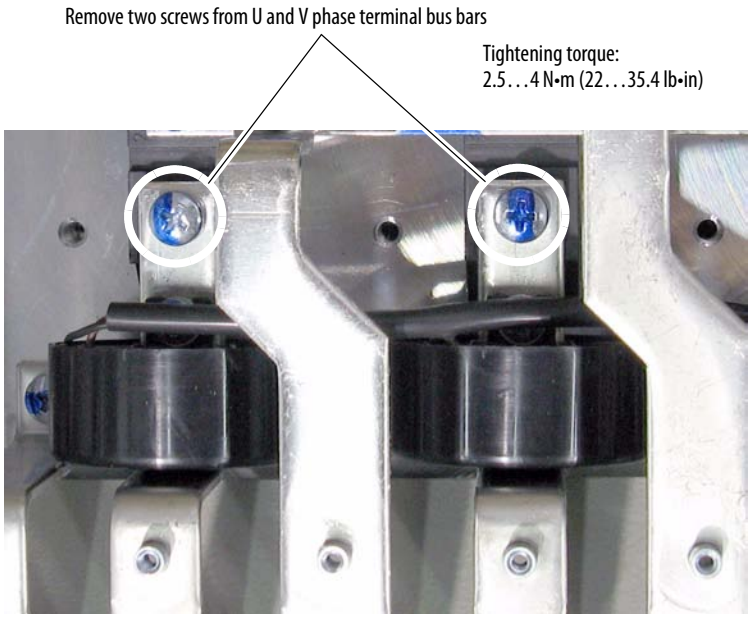
8. Remove the two 5 x 10 mm screws and washers that secure each of the U and V phase terminal bus bars to the terminal isolation strip at the bottom of the drive.



9. Remove the screws and washers that secure each of the U and V phase terminal bus bars (containing the AC current transducers) to the SCR modules.
   - For Regenerative drives, remove the top and bottom screws and washers that secure the connecting bus bars and U and V phase terminal bus bars to the SCR modules and remove the connecting bus bars.



   - For Non-Regenerative drives, remove the screws and washers that secure the U and V Phase terminal bus bars to the corresponding SCR modules.



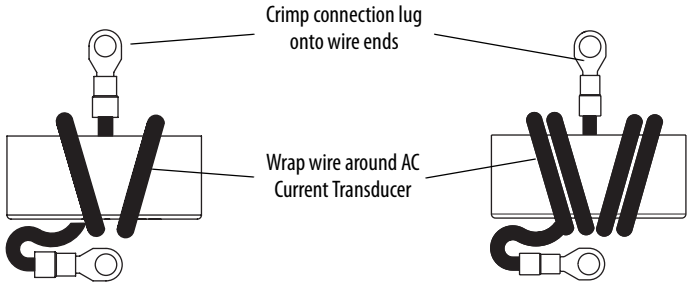
10. While lifting the terminal bus bars out of the drive, slide the AC current transducers off of the bus bars.

Install the AC Current Transducers

Install the AC current transducers in reverse order of removal.

For AC current transducers that must be wound with wire leads:

- Wind the wire leads around the new AC current transducers the exact number of times and in the same position as the wires on the AC current transducers that were removed from the power traces board.
- Crimp the connection lugs onto the wire leads before they are secured to the power traces board.



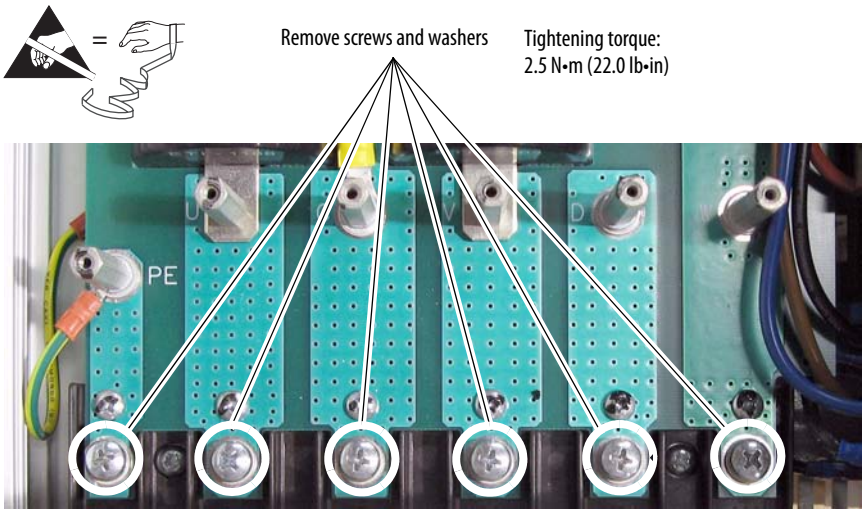
Power Traces Circuit Board Removal and Installation

Remove the Power Traces Circuit Board

Note: The power traces circuit board is only contained in frame A drives rated up to 55A/15 HP with 230V AC input and up to 52A/30 HP with 460V AC input.

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Remove the protective covers (see Protective Cover Removal and Installation on page 48).
4. Remove the M5 x 10 mm screws and washers that secure the terminal lugs (if present) and power and ground wiring to terminals U, V, W, C, D and PE at the bottom of the drive.

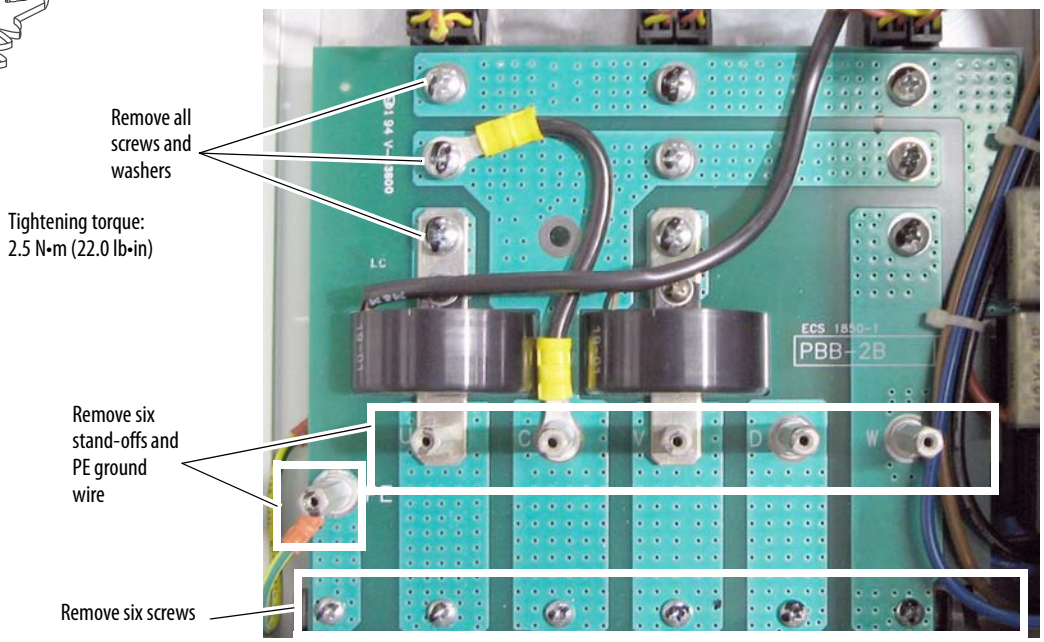
Note: Non-regenerative drive without terminal lugs shown.



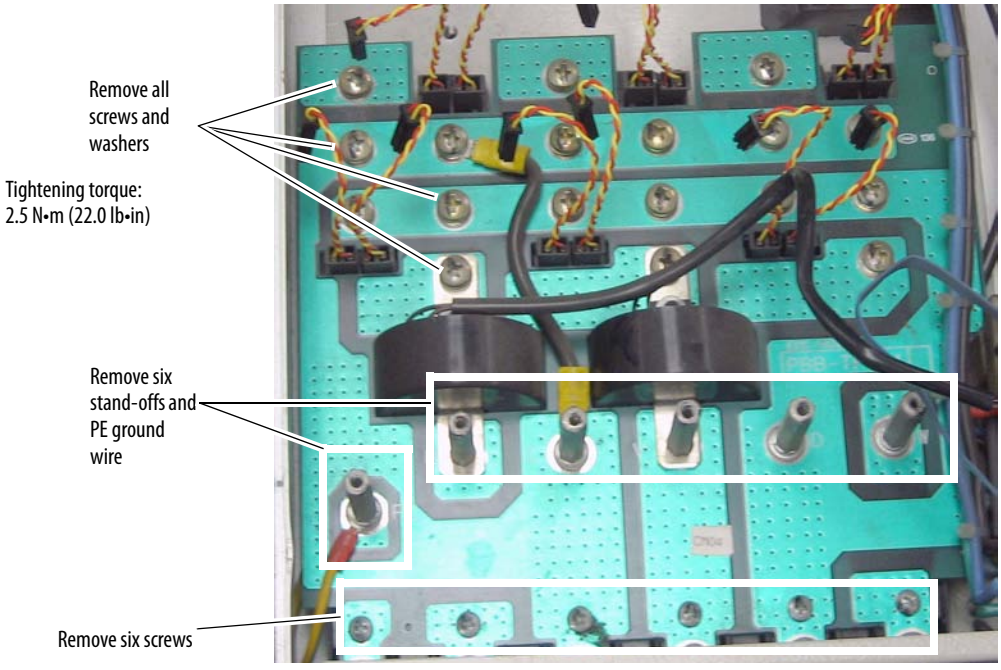
5. Remove the control EMI shield and control board (see Control EMI Shield and Control Circuit Board Removal and Installation on page 64).
6. Remove the pulse transformer and switching power supply circuit boards (see Pulse Transformer and Switching Power Supply Circuit Board Removal and Installation on page 66).

7. Remove the six stand-offs (and the ground wire) from the power traces circuit board.
8. Remove all M5 x 10 mm screws and washers that secure the board to the SCR modules and power terminal isolation strip and remove the power traces board from the drive.

Non-Regenerative drive with AC current transducers with connection bars

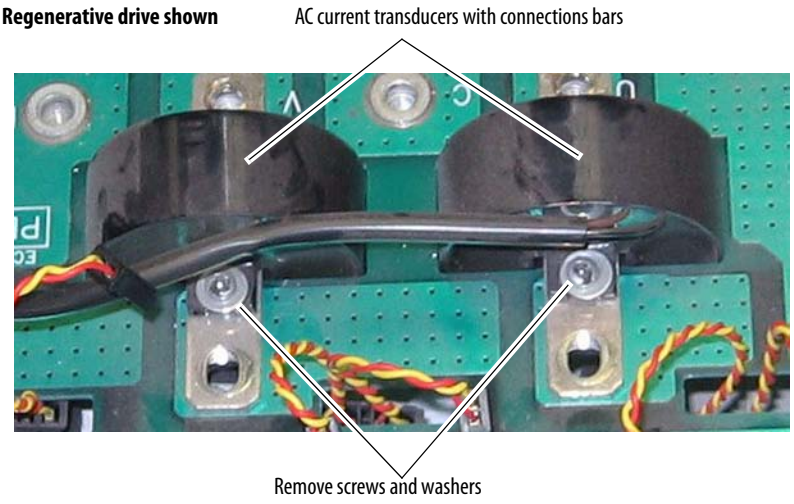


Regenerative drive with AC current transducers with connection bars



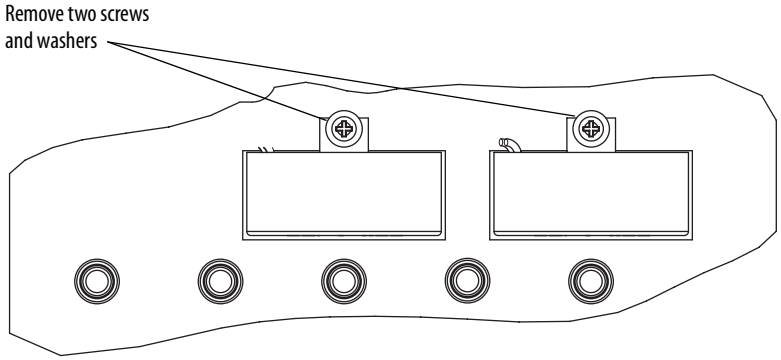
9. Remove the screw and washer that secures the top of each of the AC current transducers to the power traces board and remove the current transducers.

Regenerative drive shown



10. For drives with AC current transducers with no connection bars, turn the board over and remove the two screws and washers that secure the AC current transducers to the board and remove the AC current transducers and windings (if present) from the drive.

IMPORTANT	You do not need to remove the windings from the AC current transducers.

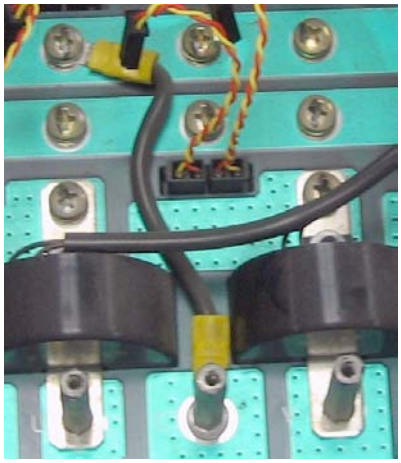


Install the Power Traces Circuit Board

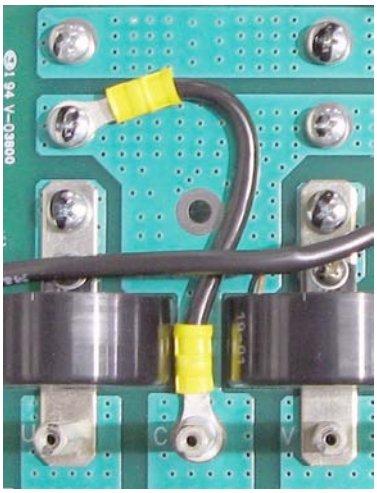
Install the power traces circuit board in reverse order of removal.

- Verify that the connecting wire on the board is placed in the exact location as previously installed and that the wires leads wound around the current transducers (if present) are in the same location as when previously installed.

Regenerative drive



Non-Regenerative drive



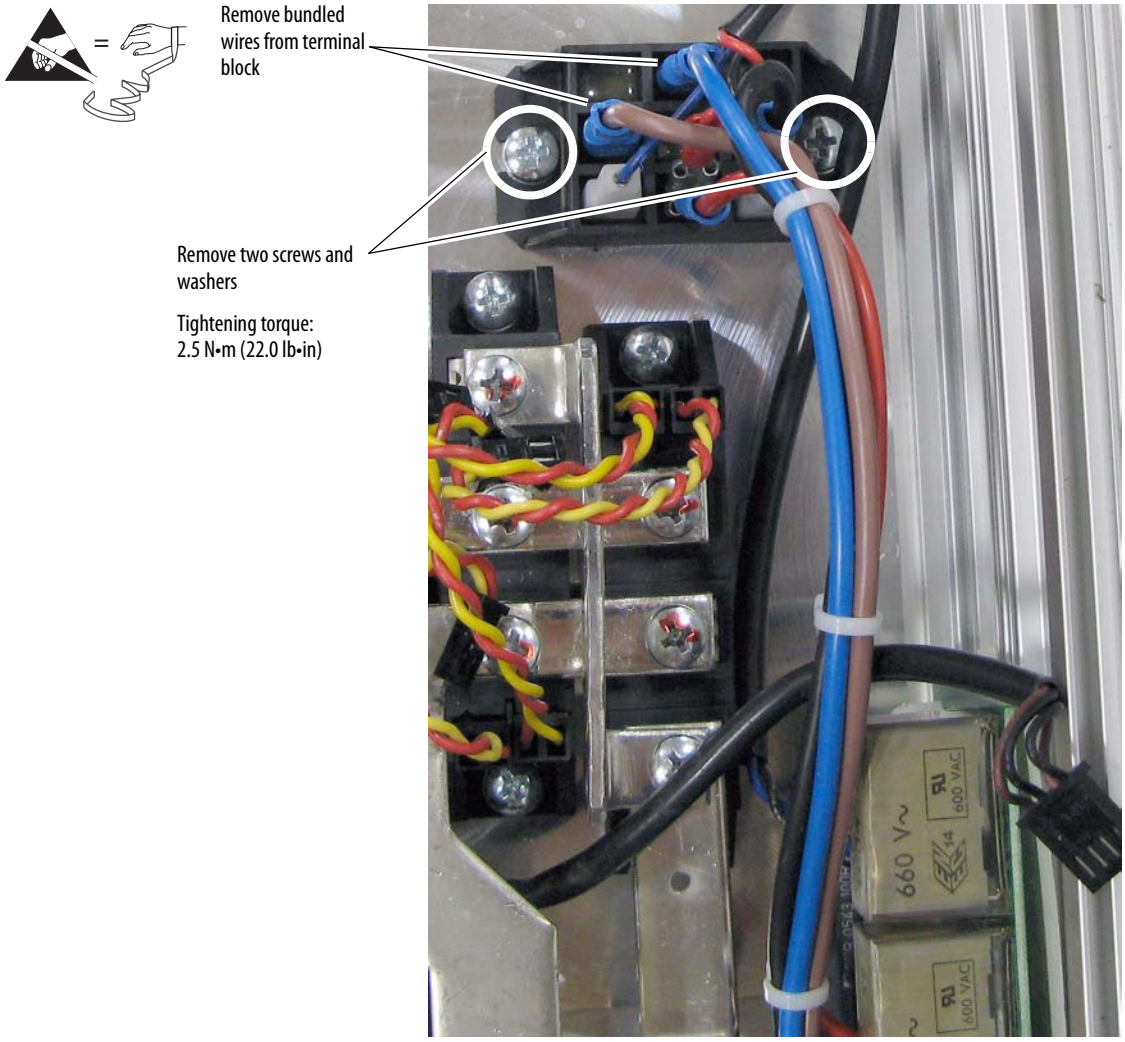
Field SCR/Dual Diode Module and Field Circuit Board Removal and Installation

Remove the Field SCR/Dual Diode Module and Field Circuit Board

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Remove the protective covers (see Protective Cover Removal and Installation on page 48).
4. Remove the control EMI shield and control circuit board (see Control EMI Shield and Control Circuit Board Removal and Installation on page 64).
5. Remove the pulse transformer and switching power supply circuit boards (see Pulse Transformer and Switching Power Supply Circuit Board Removal and Installation on page 66).

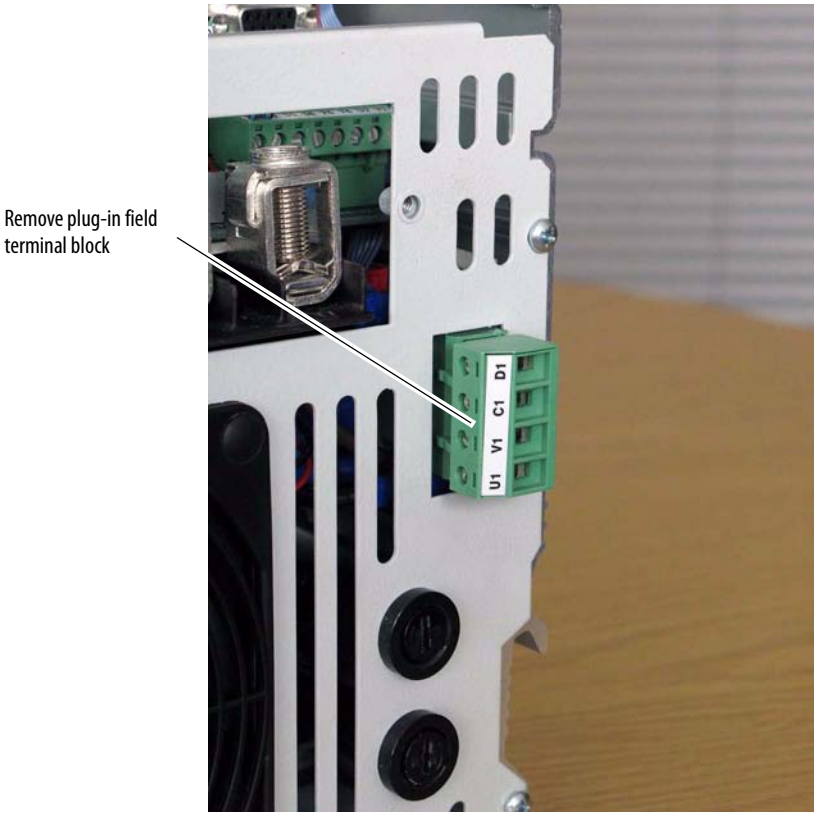
IMPORTANT	Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

6. Remove all wires from the field SCR/dual diode module on the drive heat sink. (You will also need to remove the small red wire staked to the large red wire.)
7. Remove the two M5 x 10 mm screws and washers that secure the field SCR/dual diode module to the drive heat sink and remove the module.

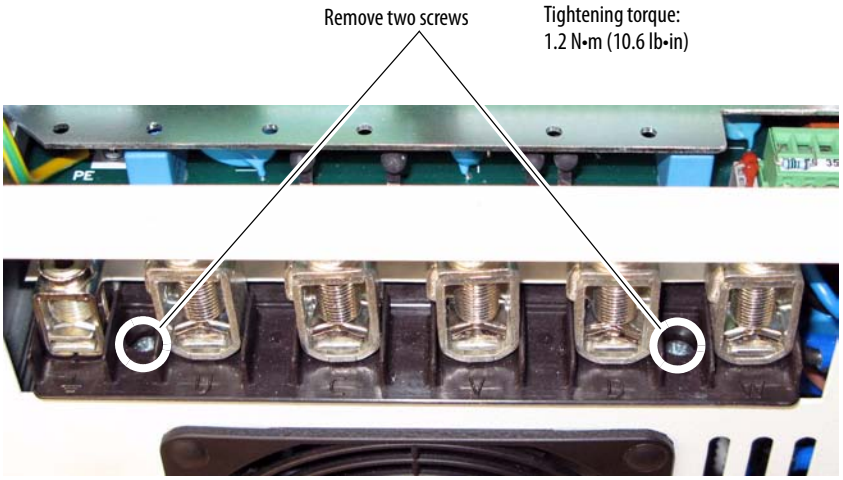


8. If necessary, remove the power wiring from terminals U, V, W, C, D, and PE.

9. Remove the plug-in field terminal block on the bottom of the drive, with the wiring kept in place.



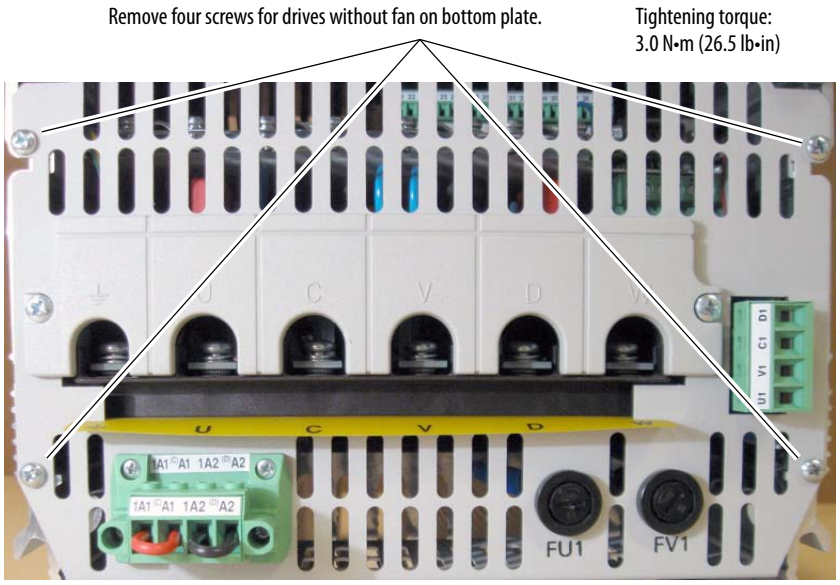
10. Remove the two M4 x 12 mm screws that secure the bottom air flow plate to the power terminal isolation strip.

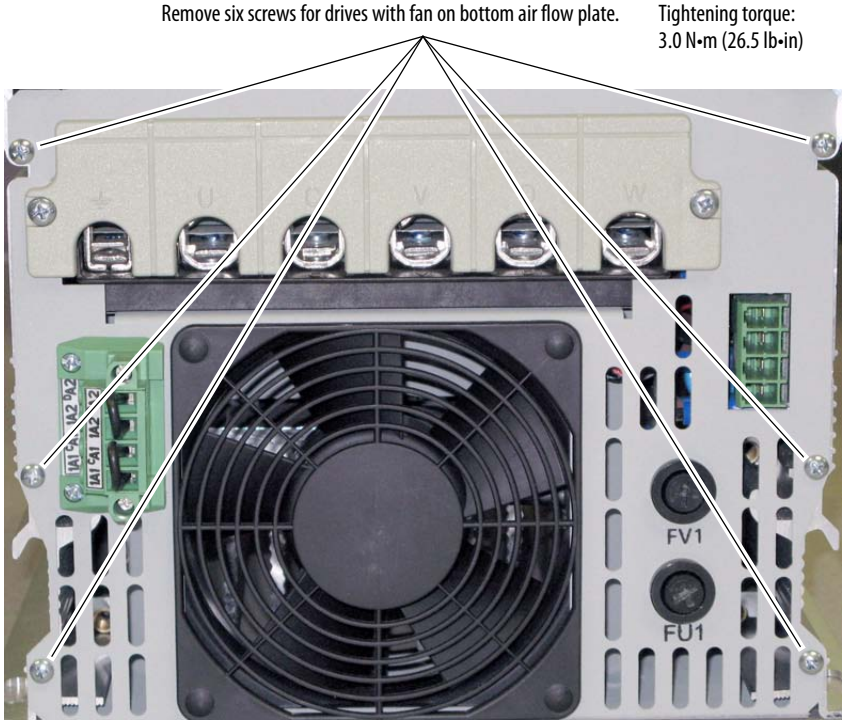


Note: Drive with fan shown.

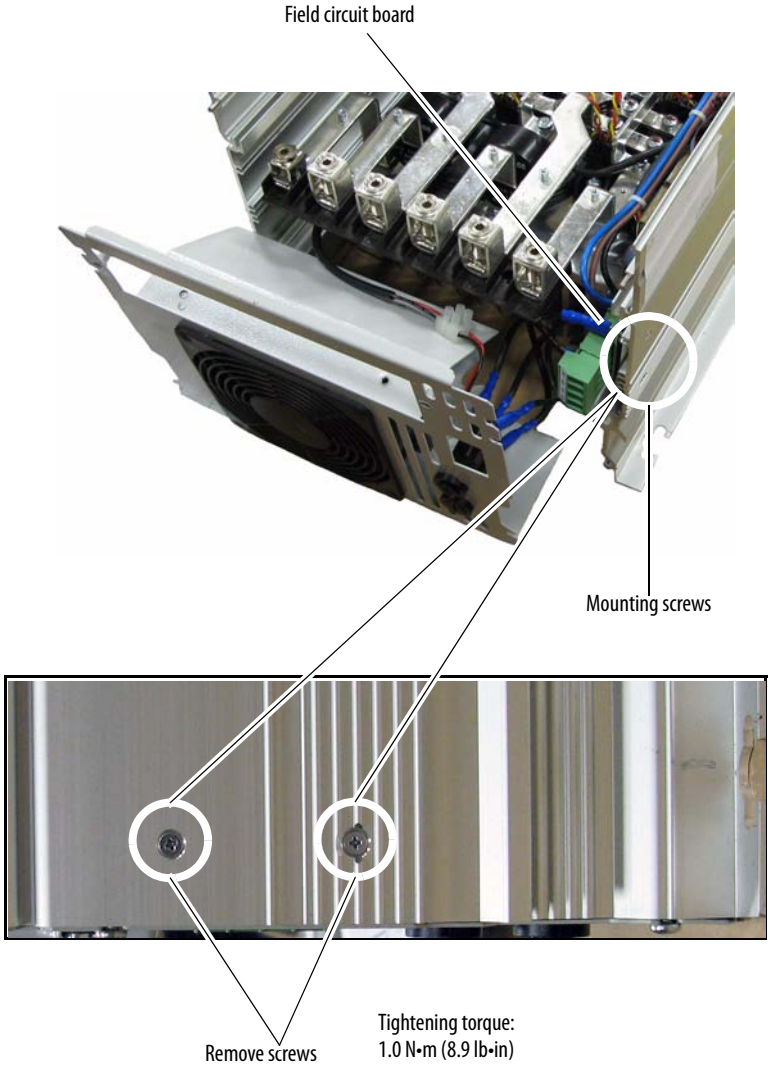
11. Remove the M4 x 12.5 mm screws that secure the bottom air flow plate to the drive chassis and carefully pull the air flow plate and fan (if present) assembly down and off the drive.

Note: Bottom air flow plates on frame A drives rated up to 55A/15 HP with 230V AC input or up to 52A/30 HP with 460V AC input, are secured to the drive chassis with four screws. Bottom air flow plates on frame A drives with a fan are secured to the chassis with six screws.

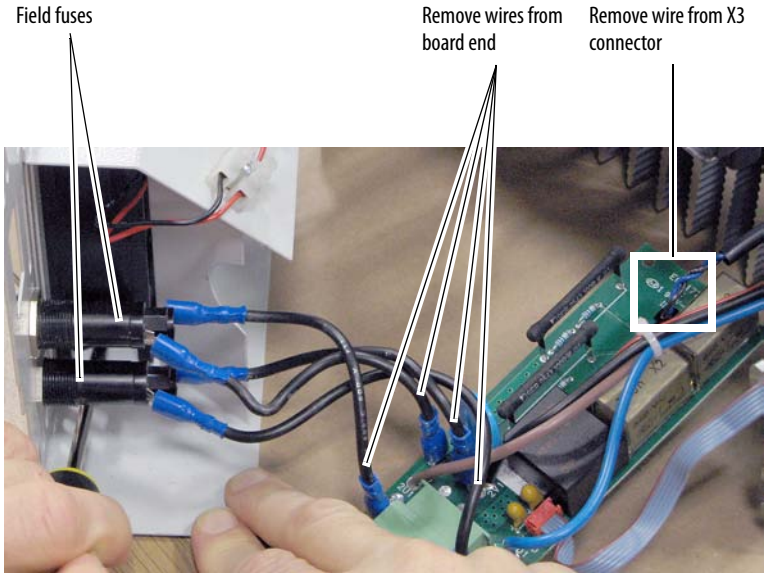




12. Remove the two M3 x 6 mm screws that secure the field circuit board to the drive and remove the field board and connected wires from the drive. Note that there is an isolation sheet below the board; do not remove this sheet unless it is damaged.



13. Remove the wires that connect the field fuses (UF, UF1, VF, VF1) to the field circuit board and the wire from connector X3 on the field board.

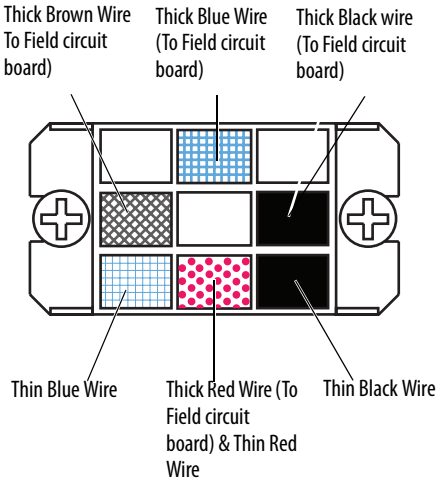


Install the Field SCR/Dual Diode Module and Field Circuit Board

- Install the field SCR/dual diode bridge module and field circuit board in reverse order of removal.

IMPORTANT	Thermal grease must be applied to the bottom of the field SCR/dual diode module before securing it to the heatsink.

IMPORTANT	Verify that the field circuit wires are connected to the correct location on the field SCR/dual diode module.



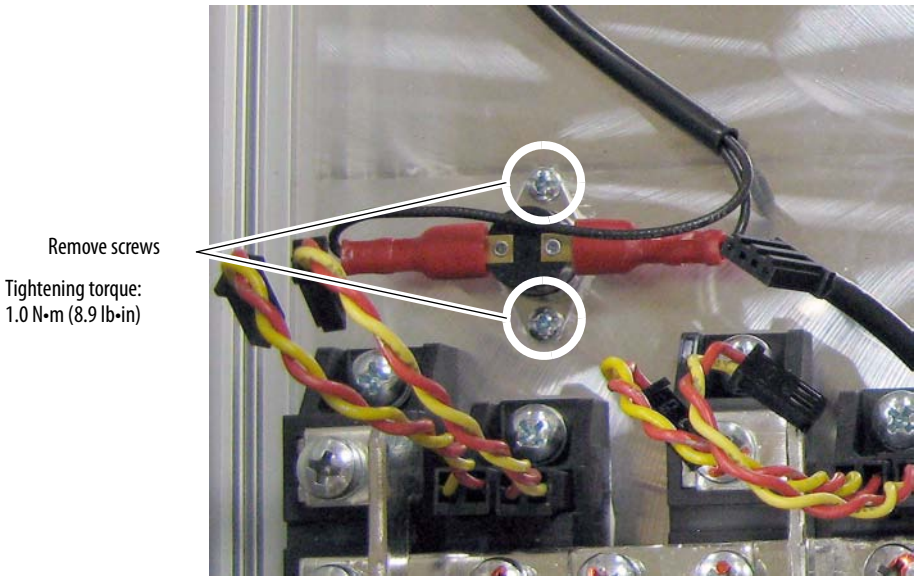
Bimetal Thermostat Removal and Installation

Remove the Bimetal Thermostat

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Remove the protective covers (see Protective Cover Removal and Installation on page 48).
4. Remove the control EMI shield and control circuit board (see Control EMI Shield and Control Circuit Board Removal and Installation on page 64).
5. Remove the pulse transformer and switching power supply circuit boards (see Pulse Transformer and Switching Power Supply Circuit Board Removal and Installation on page 66).

IMPORTANT	Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

6. Remove the two M3 x 6 mm screws that secure the thermostat to the drive heat sink and remove the thermostat and connected wires from the drive.



Install the Bimetal Thermostat

Install the thermostat in reverse order of removal.

IMPORTANT	Thermal grease must be applied to the bottom of the thermostat before securing it to the heatsink.

SCR Module Removal and Installation

Remove the SCR Modules

IMPORTANT For regenerative drives, the SCR modules must be replaced in pairs for each input phase in order that the gating resistance of each pair of modules is the same.

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).
3. Remove the protective covers (see Protective Cover Removal and Installation on page 48).
4. Remove the control EMI shield and control circuit board (see Control EMI Shield and Control Circuit Board Removal and Installation on page 64).
5. Remove the pulse transformer and switching power supply circuit boards (see Pulse Transformer and Switching Power Supply Circuit Board Removal and Installation on page 66).

   The drive rating determines how the power bridge of the drive is configured and the steps required to remove the SCR modules:

   - If removing the SCR modules from a frame A drive rated up to 55A/15 HP with 230V AC input or up to 52A/30 HP with 460V AC input, see SCR Modules on Drives Rated up to 55A/15 HP with 230V AC Input or up to 52A/30 HP with 460V AC input on page 96.

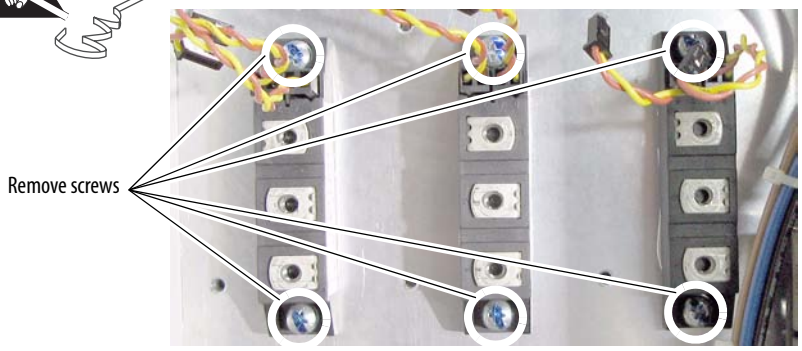
   OR

   - If removing the SCR modules from a frame A drive rated 73A/20 HP with 230V AC input and higher or 73A/40 HP with 460V AC input and higher, see SCR Modules on Drives Rated 73A/20 HP with 230V AC Input and Higher or 73A/40 HP with 460V AC Input and Higher on page 97.

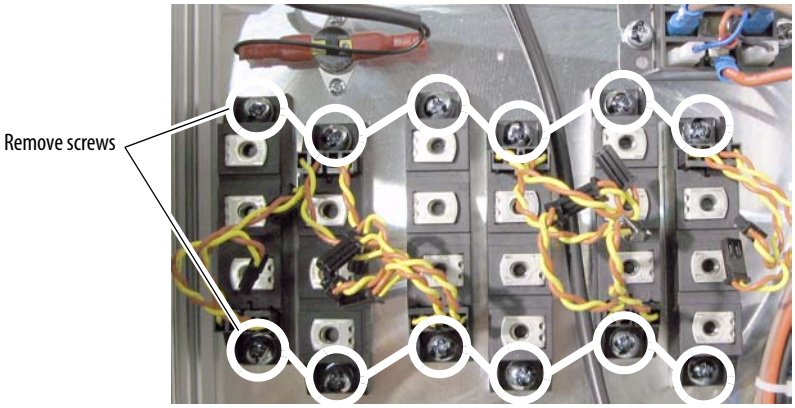
SCR Modules on Drives Rated up to 55A/15 HP with 230V AC Input or up to 52A/30 HP with 460V AC input

6. Remove the power traces circuit board. See Power Traces Circuit Board Removal and Installation on page 85. Note: The AC current transducers do NOT need to be removed from the power traces board in order to remove the SCR modules.
7. Remove the two screws and washers that secure each SCR module to the heatsink and remove the SCR modules.

Non-Regenerative drive



Regenerative drive

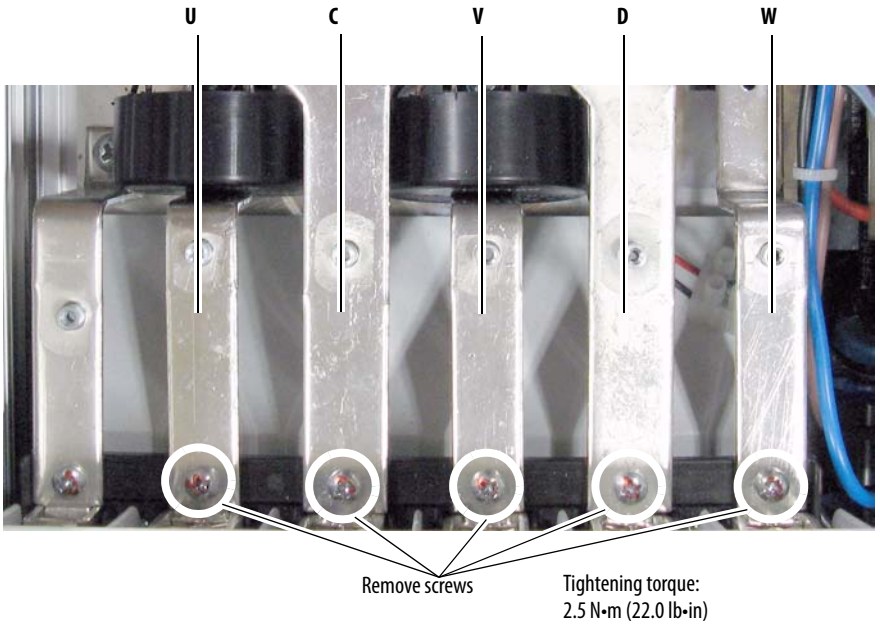


Continue with Install the SCR Modules on page 103.

SCR Modules on Drives Rated 73A/20 HP with 230V AC Input and Higher or 73A/40 HP with 460V AC Input and Higher

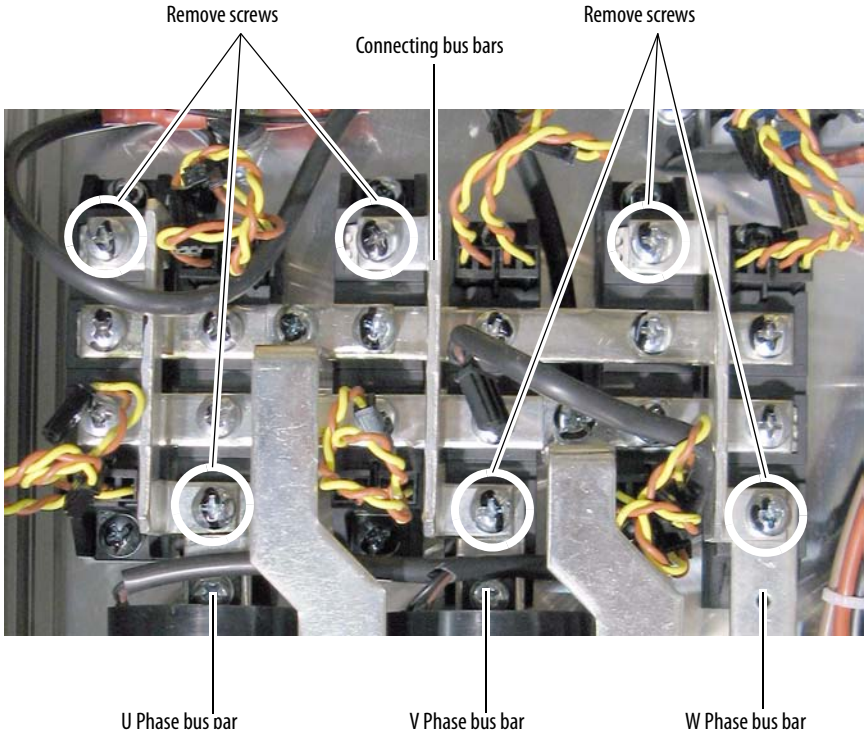
6. Remove the isolation sheet.

7. Remove the M5 x 10 mm screws that secure the U, V, W, C, and D terminal bus bars to the power terminal isolation strip at the bottom of the drive.



8. For regenerative drives only, remove the screws and washers that secure the connecting bus bars to the anodes of the corresponding SCR modules and remove the bus bars. In addition, remove the U, V and W phase terminal bus bars from the drive.

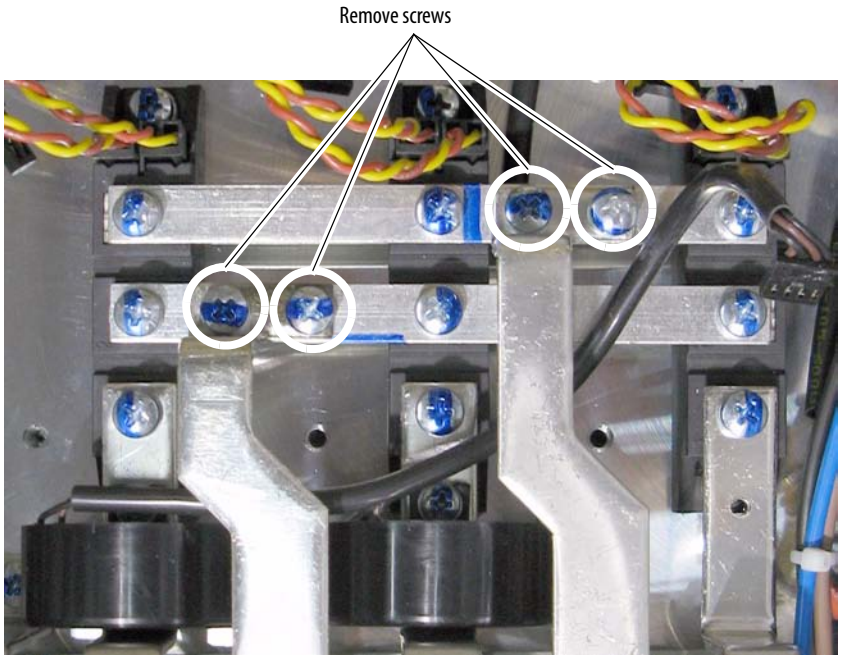
IMPORTANT	The screws that secure these bus bars to the SCR modules are M5 x 16. Retain for reuse with these bus bars only.



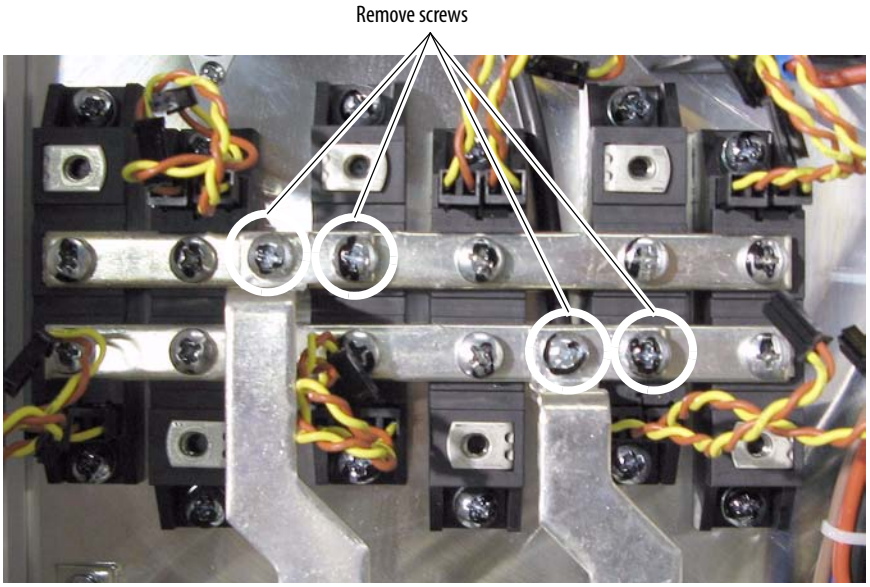
9. Remove the four screws and washers that secure the C and D terminal bus bars to the horizontal bus bars and remove the C and D terminal bus bars.

IMPORTANT	For regenerative drives only, the screws that secure these bus bars to the SCR modules are M5 x 16. Retain for reuse with these bus bars only.

Non-Regenerative drive

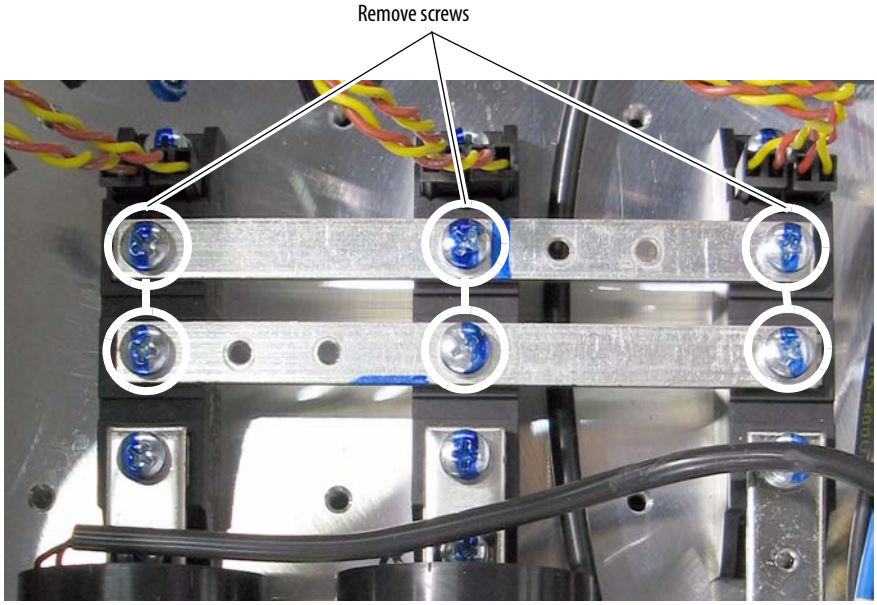


Regenerative drive

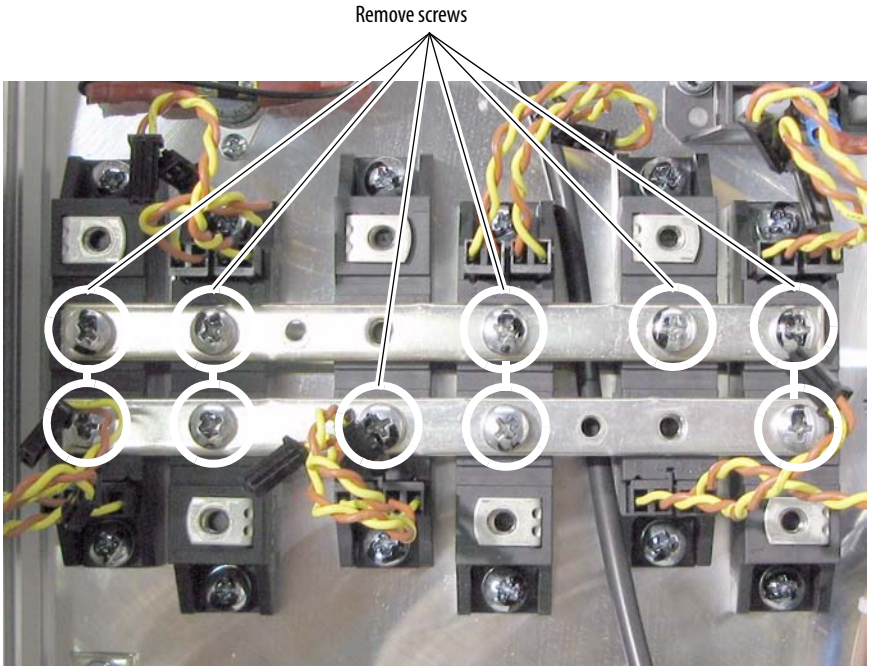


10. Remove the screws and washers that secure the connecting bus bars to the SCR modules and remove the bus bars.

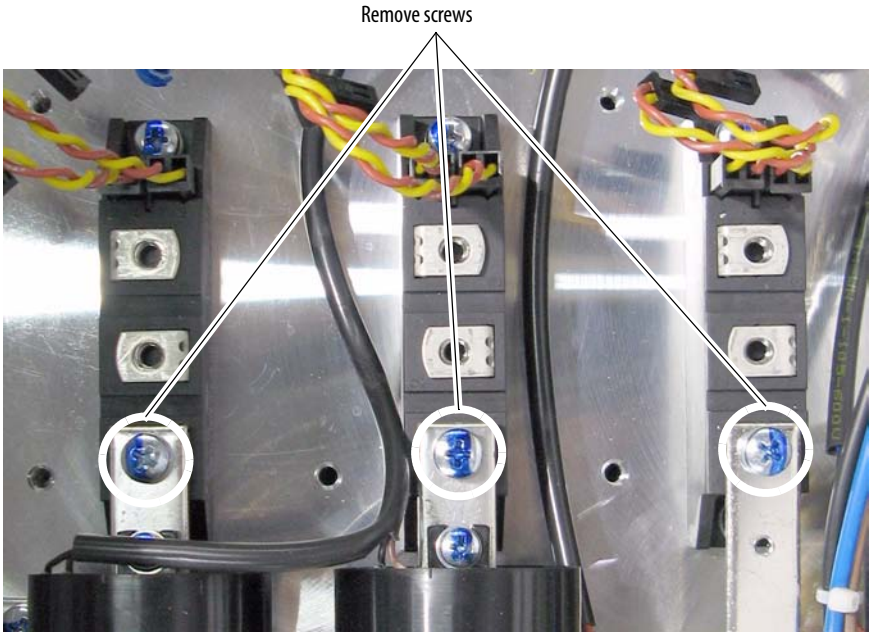
Non-Regenerative drive



Regenerative drive

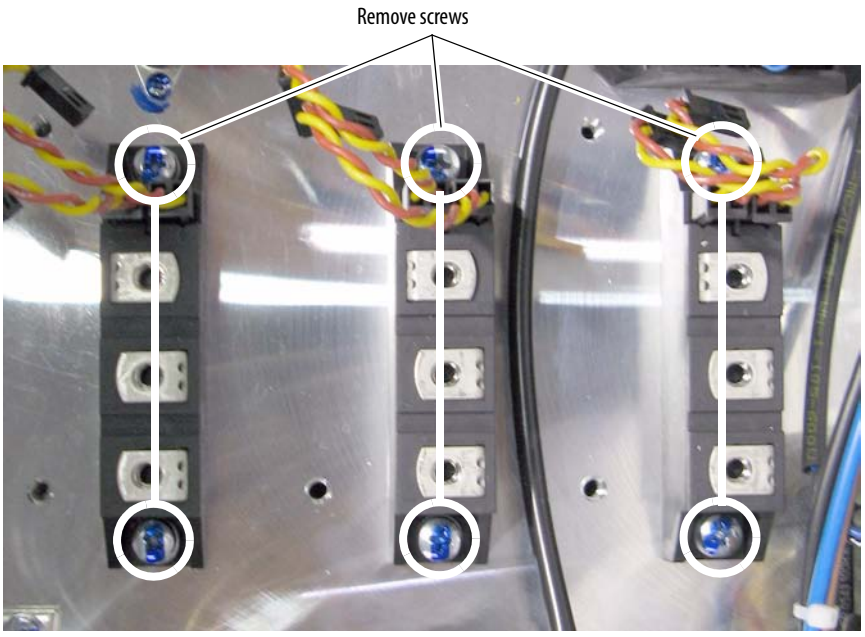


11. For non-regenerative drives only, remove the screws and washers that secure the U, V and W terminal bus bars to the SCR modules and remove the bus bars.

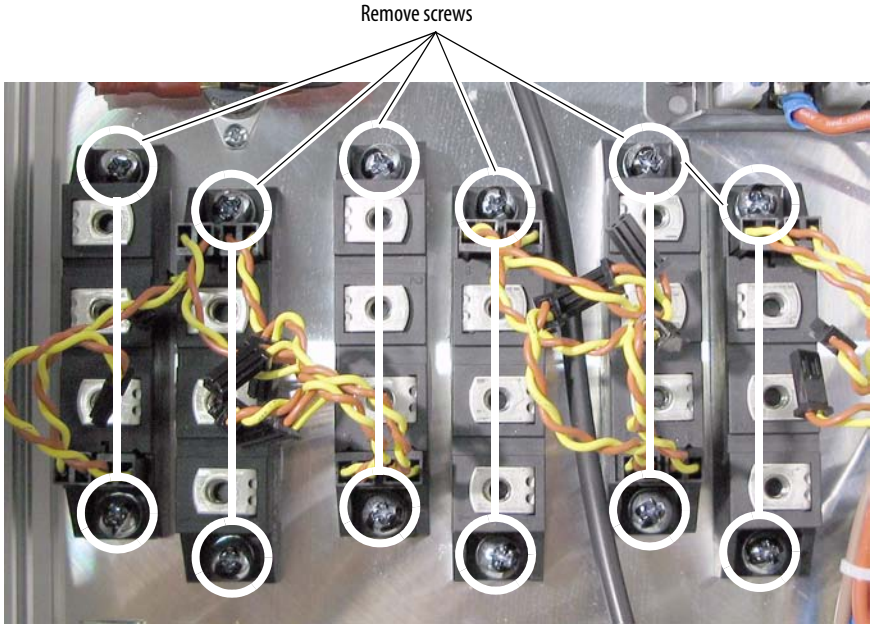


12. Remove the screws and washers that secure each SCR module to the heatsink and remove the SCR modules.

Non-Regenerative drive



Regenerative drive



Install the SCR Modules

- Install the SCR modules in reverse order of removal using the tables below for proper tightening torque.

IMPORTANT Thermal grease must be applied to the bottom of each SCR module before securing it to the heatsink.

Use the following table to determine the proper tightening torque for the SCR modules installed on the heatsink.

230V AC Input	
Part Number	**Final Torque**
SK-20P-S7F46	2.5…4 N•m (22…35.4 lb•in)
SK-20P-S7F47	2.5…4 N•m (22…35.4 lb•in)

460V AC Input	
Part Number	**Final Torque**
SK-20P-S7F75	2.5…4 N•m (22…35.4 lb•in)
SK-20P-S7F77	2.5…4 N•m (22…35.4 lb•in)

Use the following table to determine the proper tightening torque for the bus bars to SCR modules connections.

230V AC Input	
Part Number	**Final Torque**
SK-20P-S7F46	2.5…4 N•m (22…35.4 lb•in)
SK-20P-S7F47	2.5…4 N•m (22…35.4 lb•in)

460V AC Input	
Part Number	**Final Torque**
SK-20P-S7F75	2.5…4 N•m (22…35.4 lb•in)
SK-20P-S7F77	2.5…4 N•m (22…35.4 lb•in)

IMPORTANT Verify that the SCR modules are installed with the gate leads in the proper position. See Figure 15 on page 114 and Figure 16 on page 114 for SCR gate lead pinouts.

Cooling Fan Removal and Installation

Remove the Cooling Fan

1. Read the General Safety Precautions on page 12.
2. Remove power from the drive (see Remove Power from the Drive on page 44).

   The drive rating determines where the cooling fan (if any) is located in/on the drive:

   - See Cooling Fan on Drives Rated 38A/10 HP and 55A/15 HP with 230V AC Input and 35A/20 HP, 45A/25 HP and 52A/30 HP with 460V AC Input on page 104.

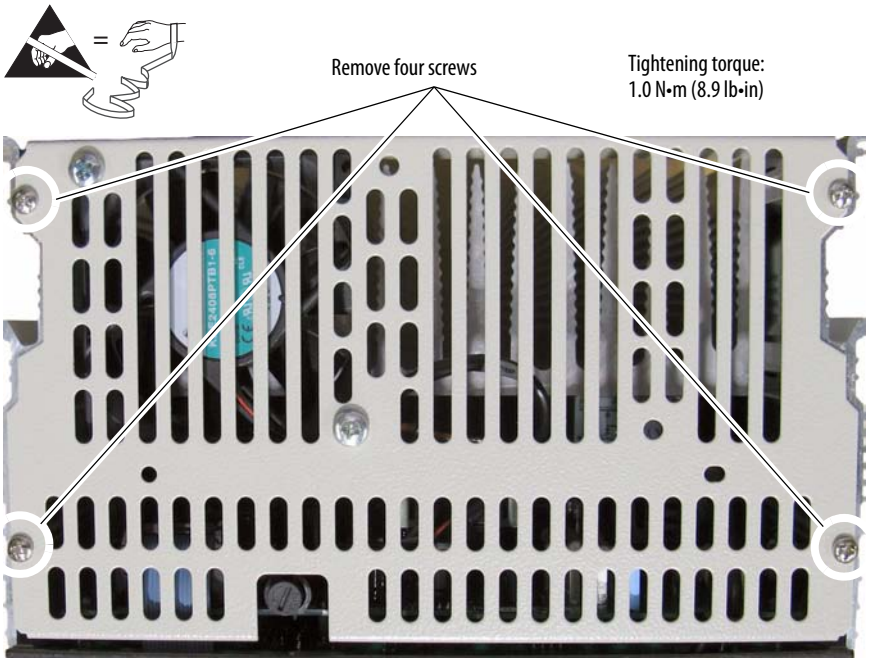
   OR

   - See Cooling Fan on Drives Rated 73A / 20 HP with 230V AC Input and 73A / 40 HP with 460V AC Input on page 105.

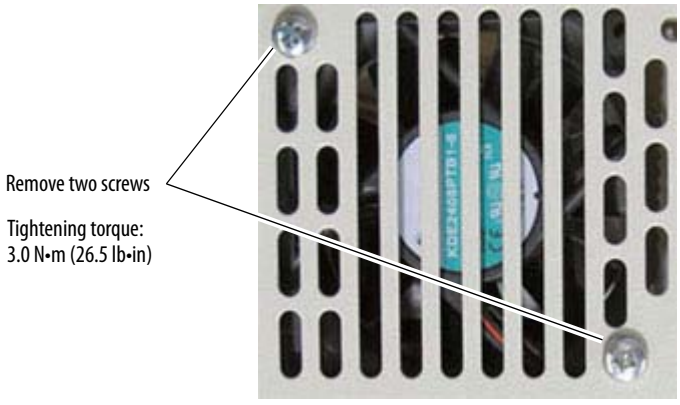
Cooling Fan on Drives Rated 38A/10 HP and 55A/15 HP with 230V AC Input and 35A/20 HP, 45A/25 HP and 52A/30 HP with 460V AC Input

Frame A drives rated 38A/10 HP and 55A/15 HP with 230V AC input and 35A/20 HP, 45A/25 HP and 52A/30 HP with 460V AC input have a cooling fan installed at the top of the drive.

3. Remove the four screws that secure the slotted air flow plate and fan to the top of the drive. The fan is connected via a cable to the switching power supply board and therefore will not pull free from the drive until the cable is disconnected. See Step 3 below for instructions.



4. Disconnect the fan cable from connector XV on the switching power supply board and remove the fan and air flow plate.
5. Remove the twoM4 x 12.5 mm screws that secure the fan and spacers to the air flow plate and remove the fan.

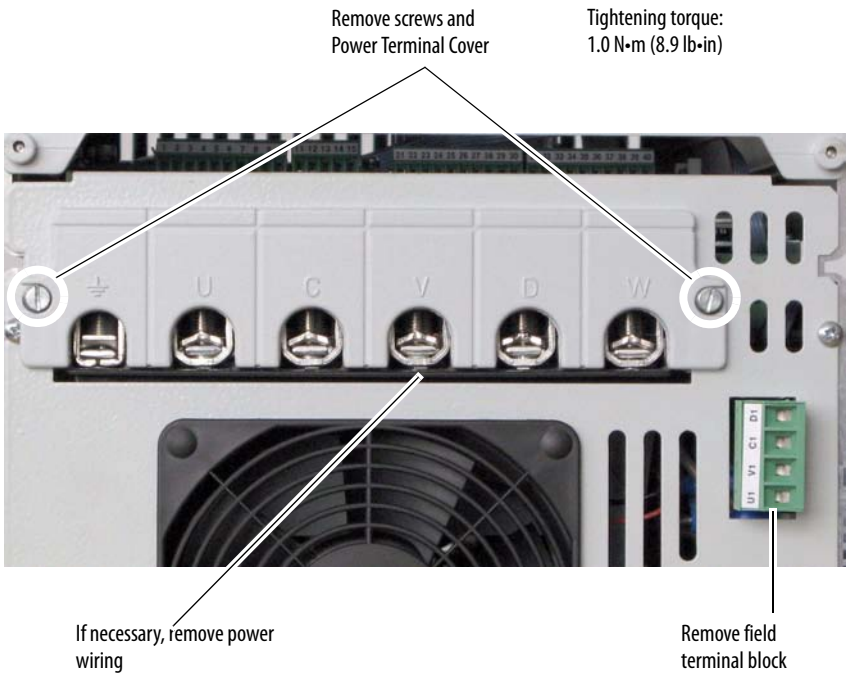


Continue with Install the Cooling Fan on page 107.

Cooling Fan on Drives Rated 73A / 20 HP with 230V AC Input and 73A / 40 HP with 460V AC Input

Frame A drives rated 73A/20 HP with 230V AC and 73A/40 HP with 460V AC and higher have a cooling fan installed on the bottom of the drive.

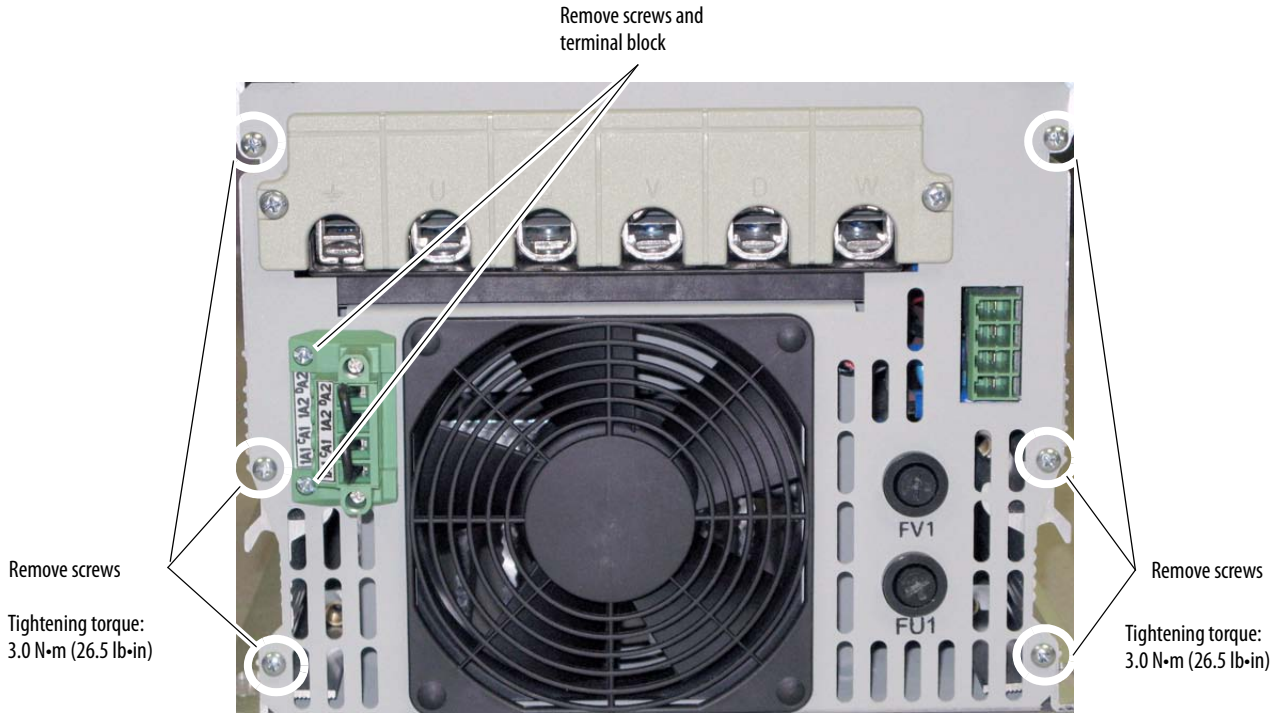
3. Loosen the two screws that secure the power terminal cover to the drive and slide the cover down and off the chassis.
4. Remove the field terminal block.
5. If necessary, remove the power wiring from the drive terminals.

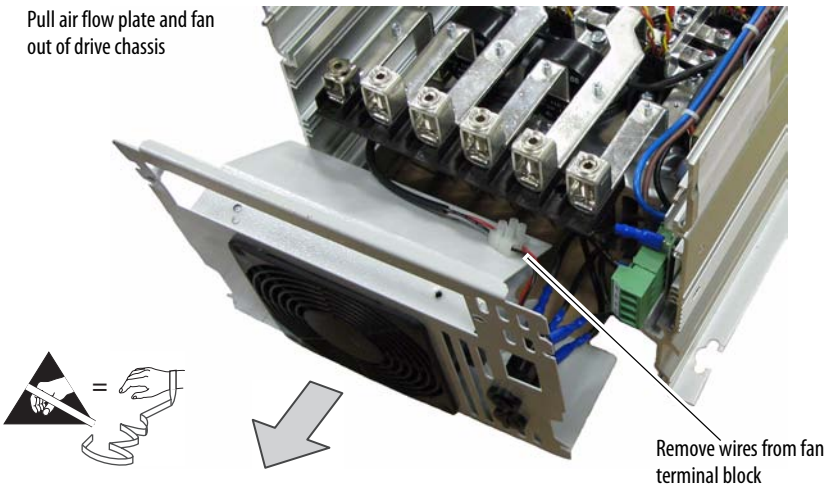


6. Remove the two screws that secure the armature voltage feedback terminal block to the air flow plate and remove the terminal block.
7. Remove the six M4 x 12.5 mm screws that secure the air flow plate to the bottom of the drive chassis and carefully pull the air flow plate and fan assembly down and off the drive.

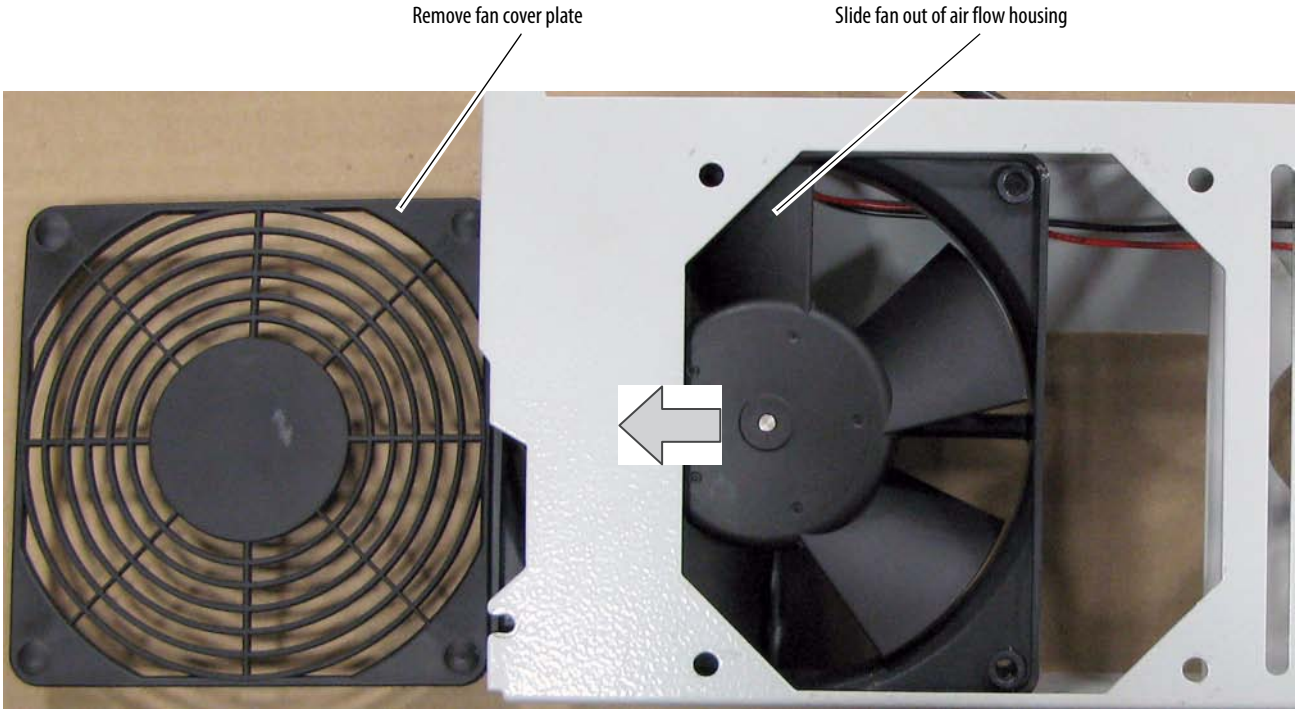
IMPORTANT	Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

8. Disconnect the (black and red) wires from the fan terminal block located on the air flow plate.





9. Using a flathead screwdriver, pry the fan cover plate off of the air flow plate and slide the fan out of the air flow housing.

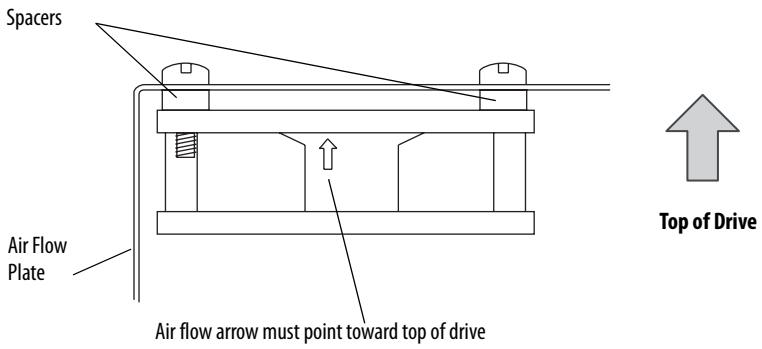


Install the Cooling Fan

Install the cooling fan in reverse order of removal.

IMPORTANT	For both drive/fan configurations, verify that the air flow arrow on the fan is pointed toward the top of the drive.

IMPORTANT	For drives with a fan connected to the top air flow plate, verify that the two spacers are properly placed during installation.



Notes:

Start-Up After Repair

Before applying power to a repaired drive, perform the following tests:

- Check the Armature SCR Modules on page 29
- Check the Field SCR/Dual Diode Module on page 36
- Complete the Test With the Motor, Without a Mechanical Load below.

Test With the Motor, Without a Mechanical Load

This test allows you to measure several operating parameters and diagnose problems without connecting the motor to its mechanical load.

This procedure requires a HIM to configure and autotune the drive. If you prefer, you can use the DriveExplorer™ or DriveExecutive™ software.

ATTENTION: Power must be applied to the drive to perform the following start-up procedure. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, **Do Not Proceed. Remove Power** including user supplied control voltages. User supplied voltages may exist even when main AC power is not applied to then drive. Correct the malfunction before continuing.

1. Verify that the input power wiring and grounding is connected.
2. Verify that the motor cables are connected.
3. Verify that the motor load is disconnected.
4. Verify that the control board DIP switches are set correctly. See Install the Control Circuit Board on page 63 for more information.
5. Apply power to the control circuits (terminals U2 and V2) of the drive.
6. Verify that the following parameter values are set correctly:
   - 45 [Max Ref Speed] is set to the motor nameplate base speed.
   - 162 [Max Feedback Spd] is set to the motor nameplate base speed.
   - 175 [Rated Motor Volt] is set to the motor rated nameplate armature voltage.
   - 179 [Nom Mtr Arm Amps] is set to the rated motor nameplate armature current.

- 280 [Nom Mtr Fld Amps] is set to the rated motor nameplate field current.
- 374 [Drv Fld Brdg Amps] is set to the rated current of the field bridge regulator

7. Energize the drive.
8. Measure the field current and verify that the value is reflected in parameter 234 [Fld Current Pct].
9. Run the following applicable Autotune procedures detailed in Chapter 2 of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001.
   - Tune the Current Regulator
   - Verify Motor Rotation Direction and Run Feedback Polarity Checks. If parameter 414 [Fdbk Device Type] is set to 3 "Armature", set parameter 107 [Speed Zero Level] to a minimum value of 10% of base motor speed.
   - Configure the Speed Feedback Parameters
   - Tune the Speed Regulator
10. Make configuration changes that allow the HIM to issue start and speed commands.
11. Start the drive, by pressing  (the start button).

    If the drive will not start, verify that you have correctly installed any replacement components.

    If any faults are displayed on the HIM, refer to Chapter 4 - Troubleshooting in the PowerFlex Digital DC Drive User Manual, publication 20P-UM001.
12. Increase the speed command from zero to base speed, by pressing  (the up button).
13. Measure the output voltage and verify that it is reflected in parameter 233 [Output Voltage].
14. Measure the armature current and verify that the value is reflected in parameter 199 [Arm Current Pct].
15. Stop the drive, by pressing  (the stop button).
16. If these measurements are correct, re-configure the drive to suit the application. Refer to Chapters 1 and 2 of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001 for assistance.

    If any of these measurements are incorrect, repeat steps 8...15. If the measurements are still incorrect, repeat the appropriate procedures in Chapter 2 - Component Test Procedures beginning on page 15.

Schematics

List of Schematic Diagrams

Figure 12 - Drive Interconnection Diagram

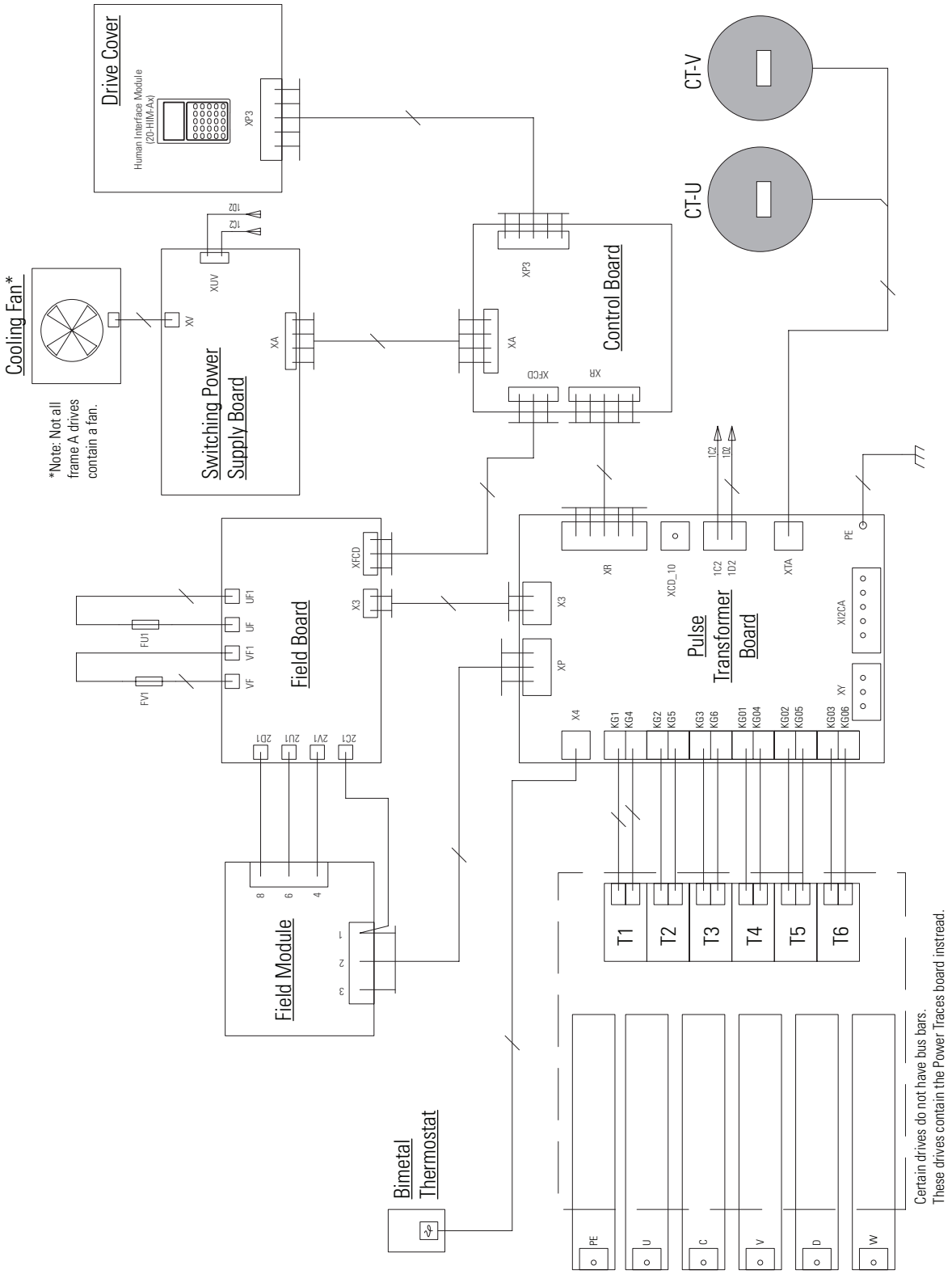


Figure 13 - AC Line Measurement Points Diagram

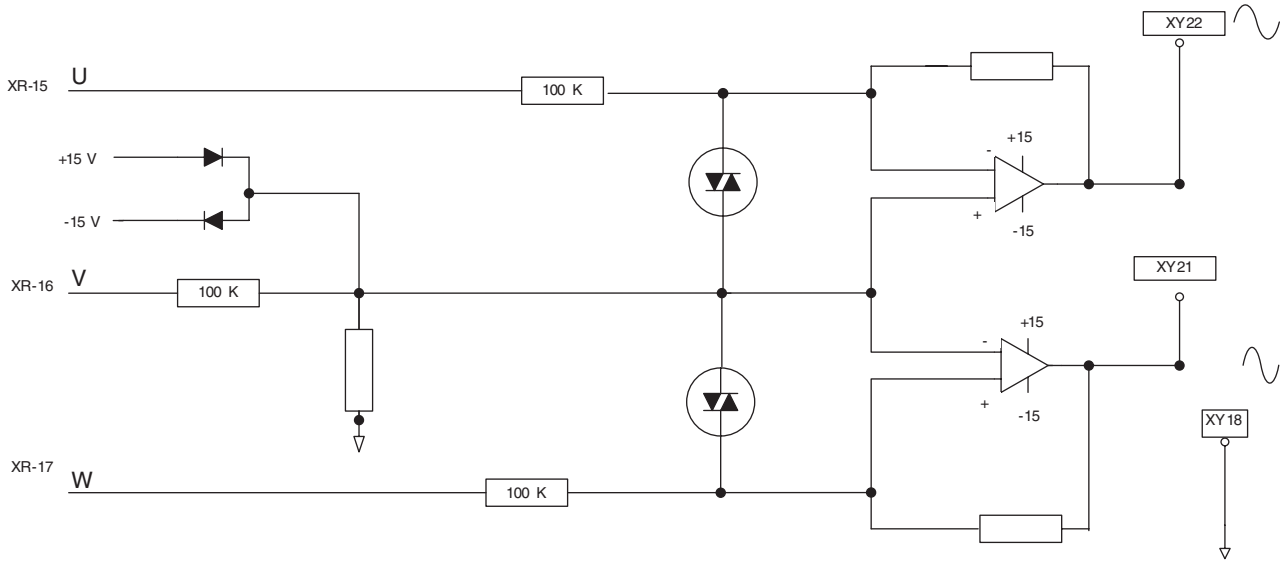


Figure 14 - Power Feedback Connections Diagram

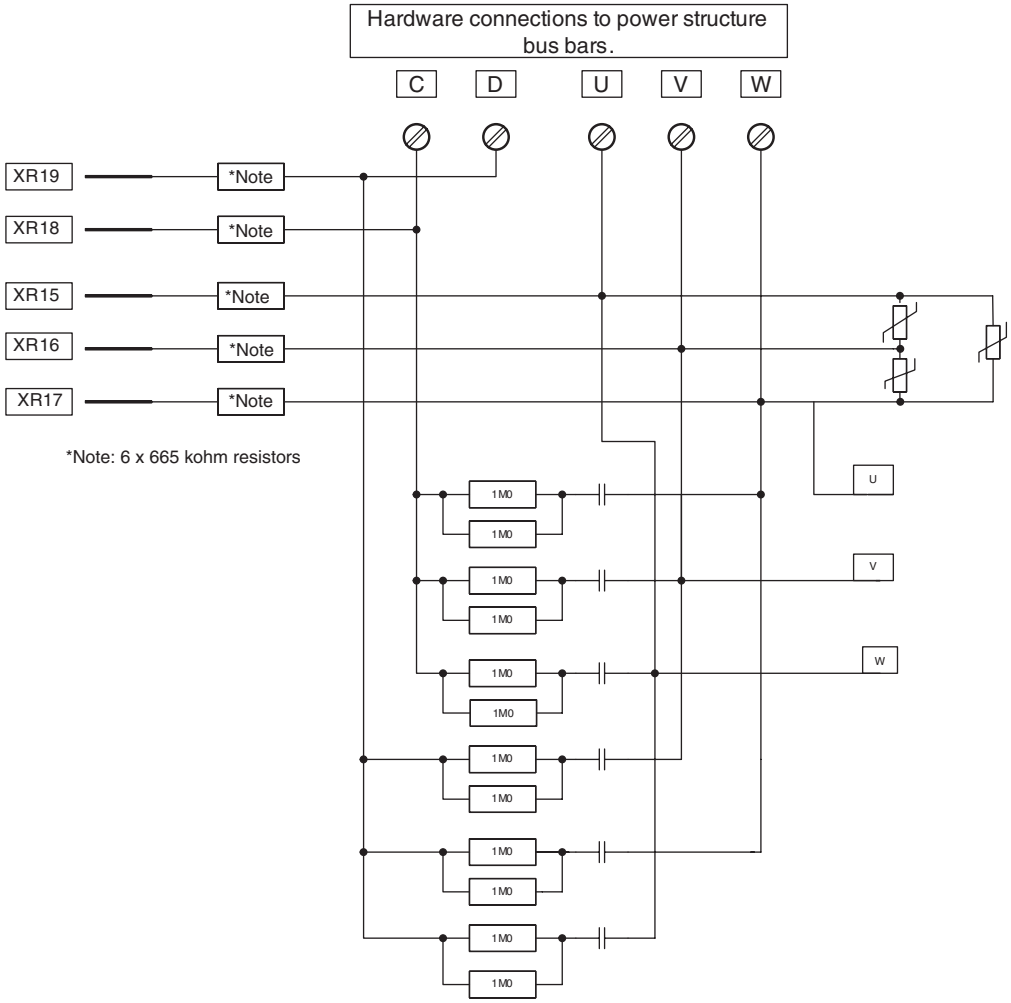


Figure 15 - SCR to Pulse Transformer Board Gate Lead Pinout - Regenerative Drive Diagram

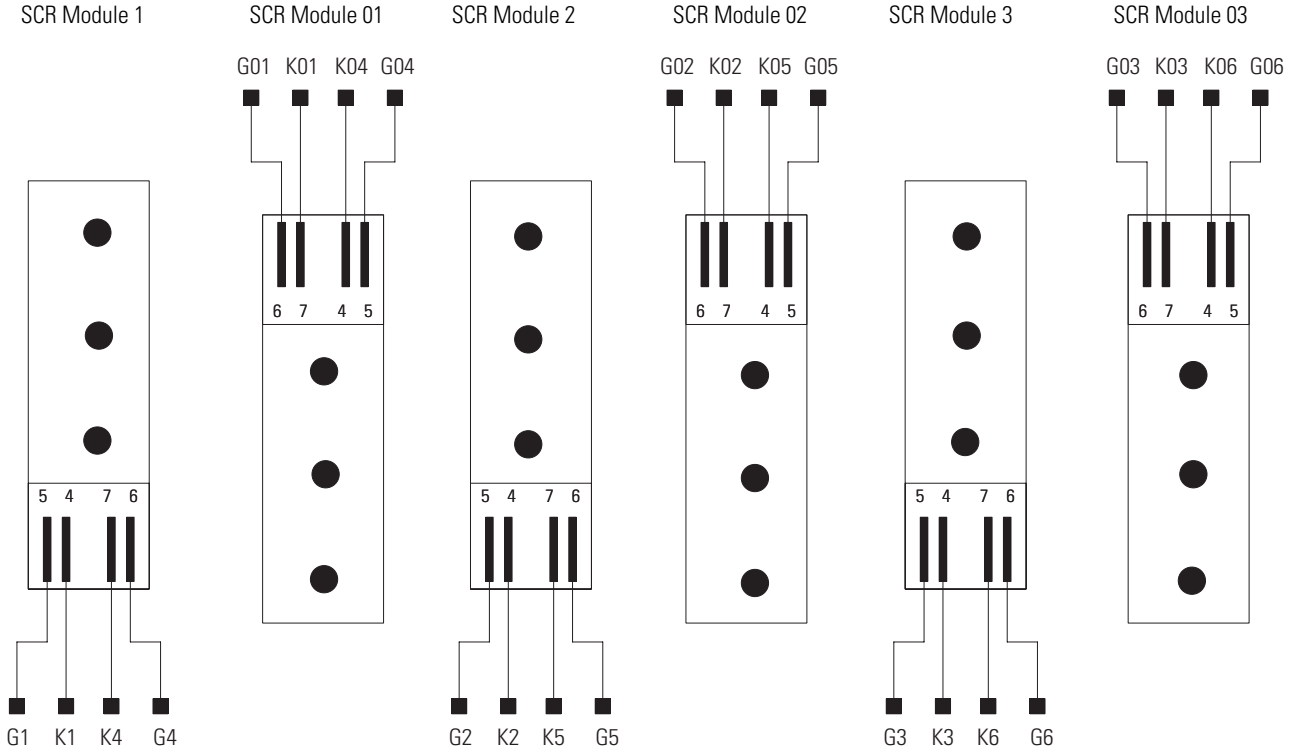


Figure 16 - SCR to Pulse Transformer Board Gate Lead Pinout - Non-regenerative Drive Diagram

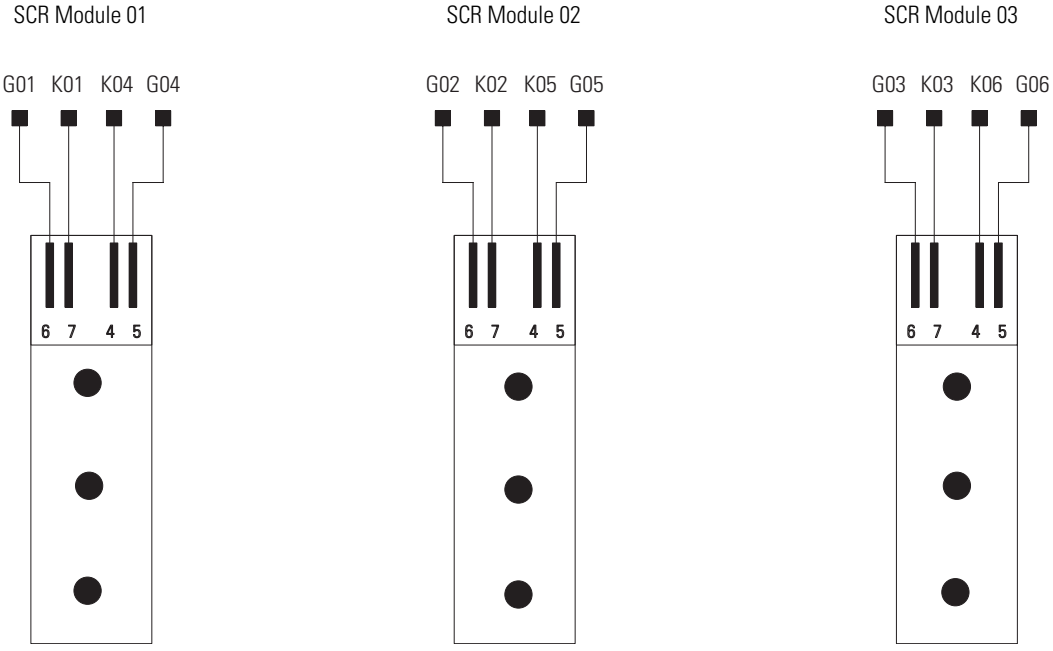


Figure 17 - Field Board and SCR/Dual Diode Module Connections Diagram

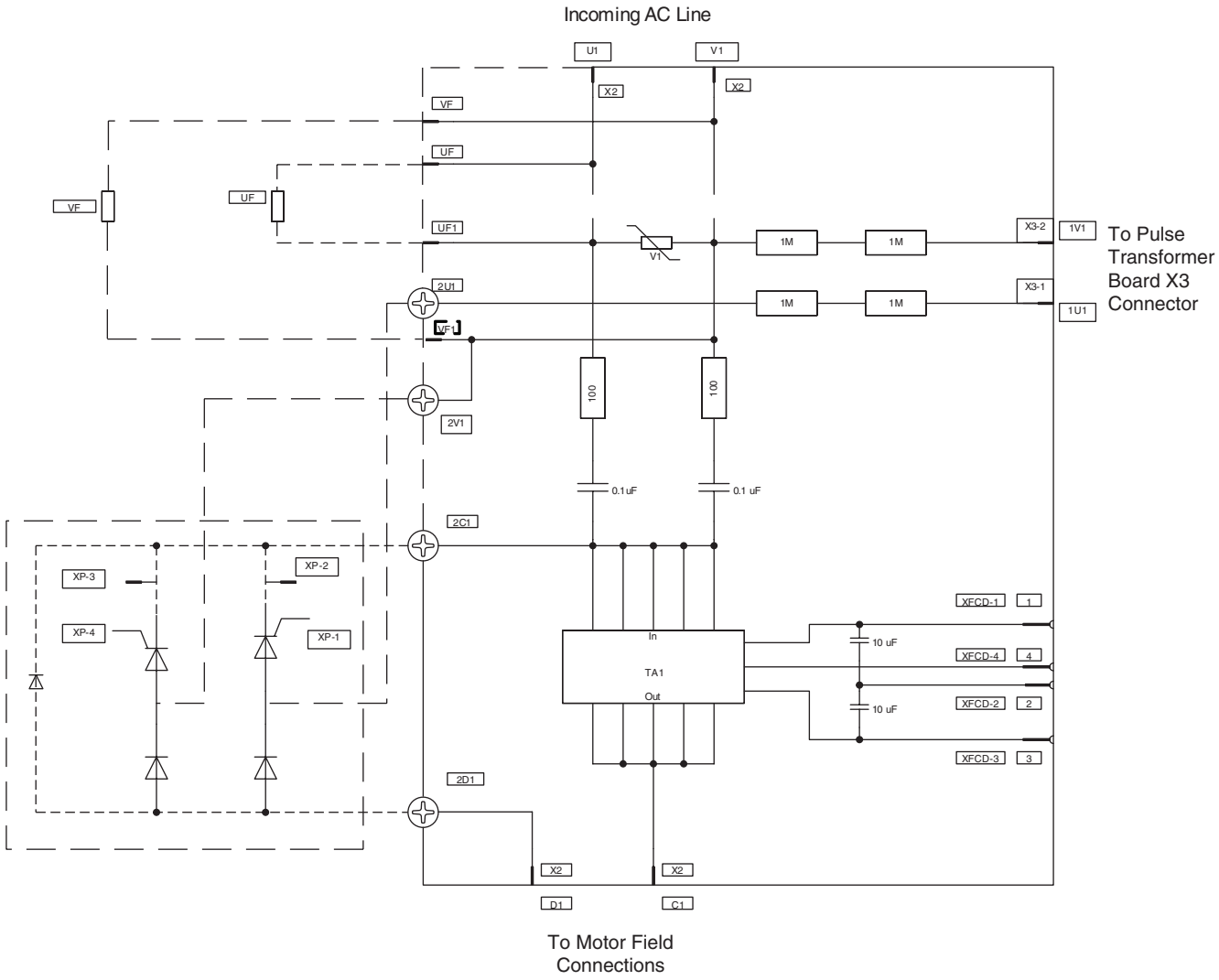


Figure 18 - Field Control Circuit Diagram

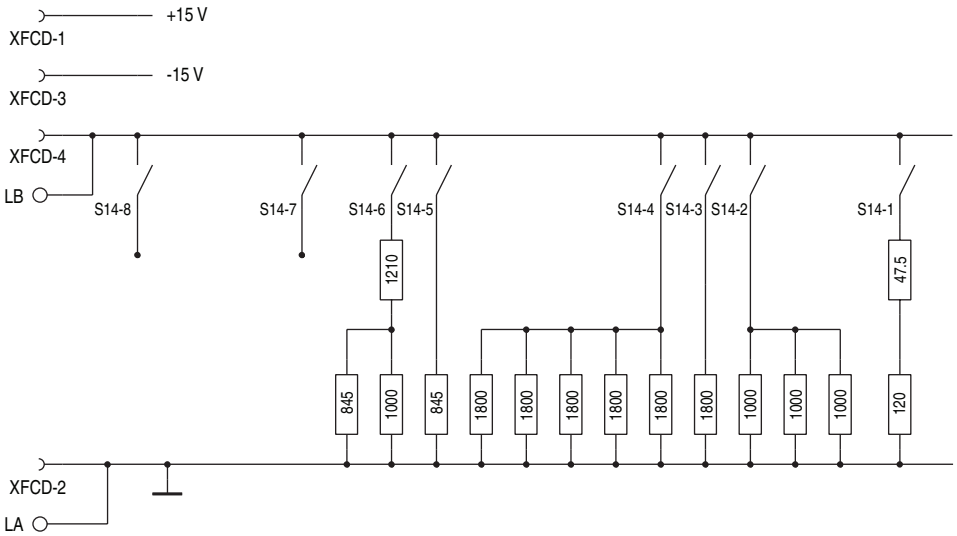


Figure 19 - Control Circuit Input Power Diagram

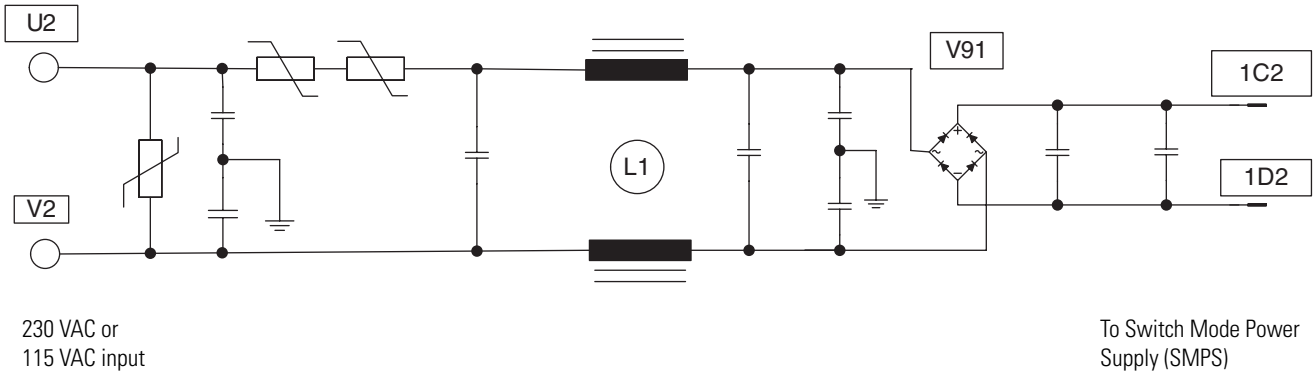


Figure 20 - Encoder Control Circuit Diagram

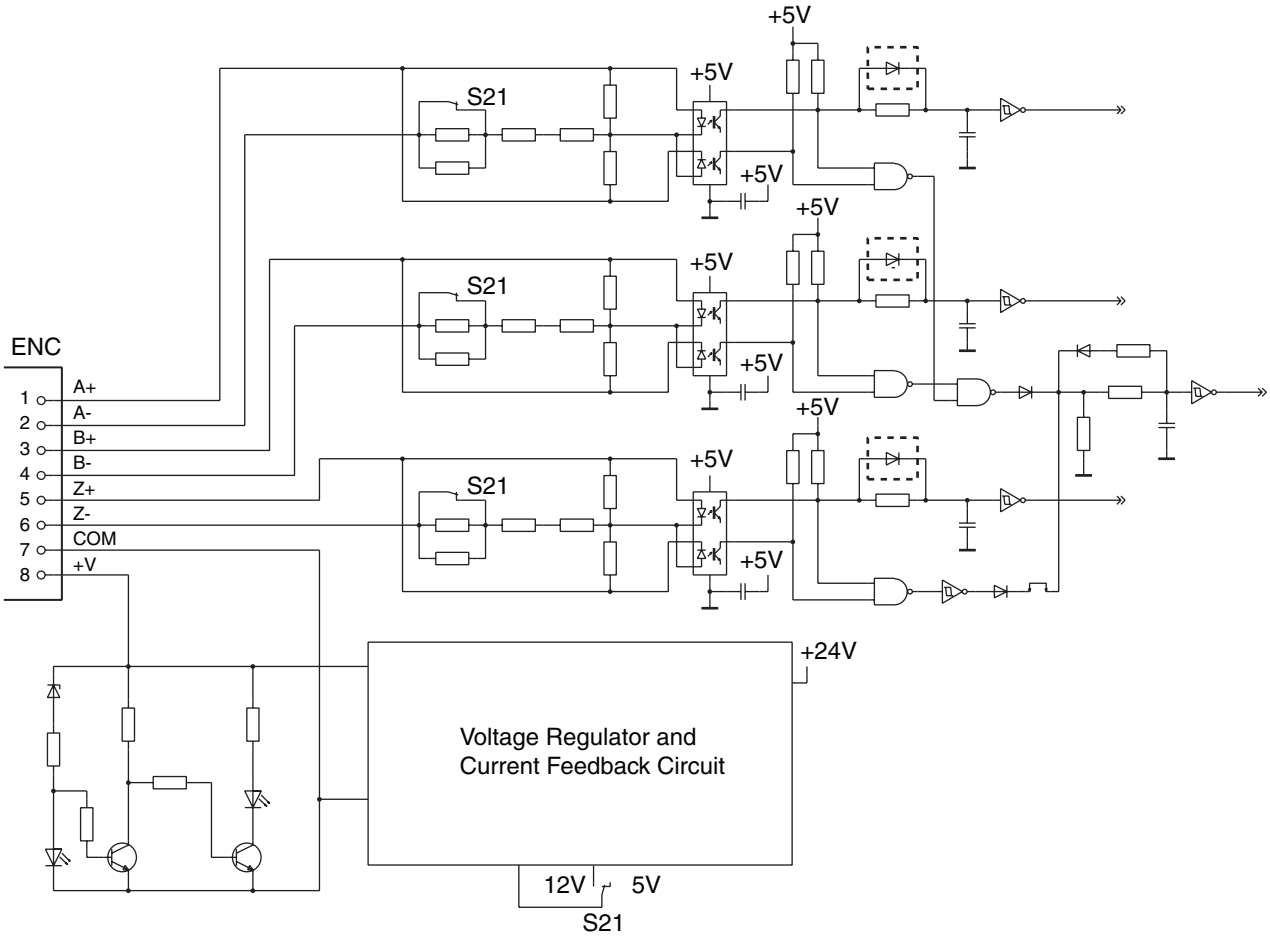


Figure 21 - DC Tachometer Control Circuit Diagram

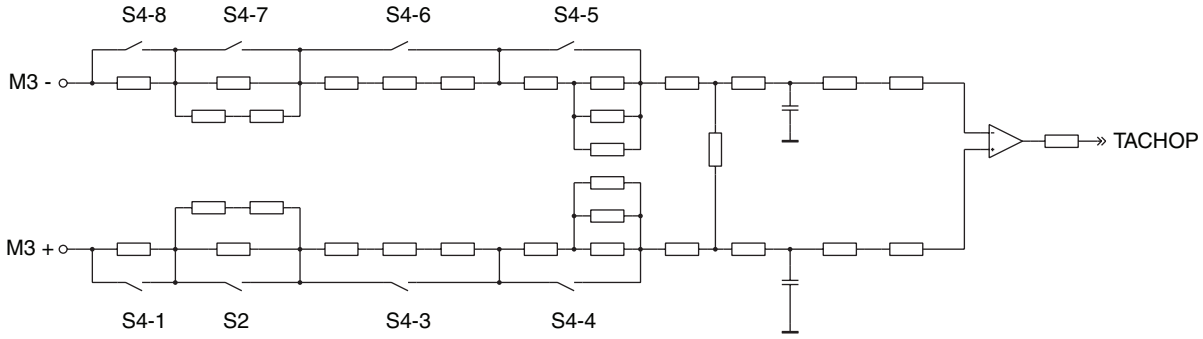


Figure 22 - Motor Thermal Protection Control Circuit Diagram

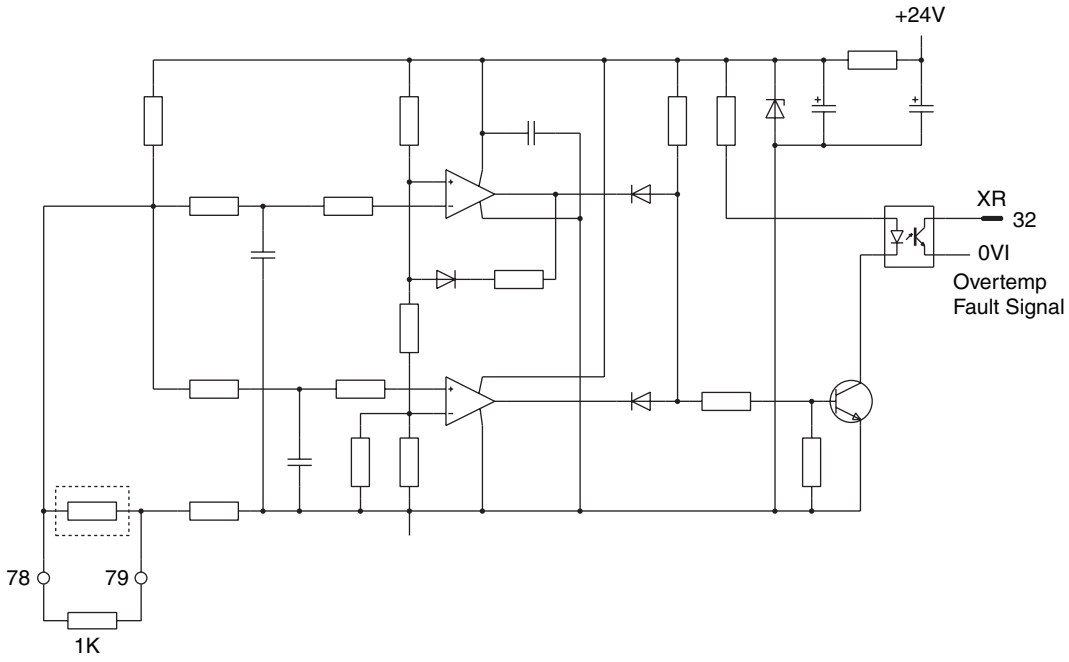


Figure 23 - Drive Heatsink Monitoring Control Circuit Diagram

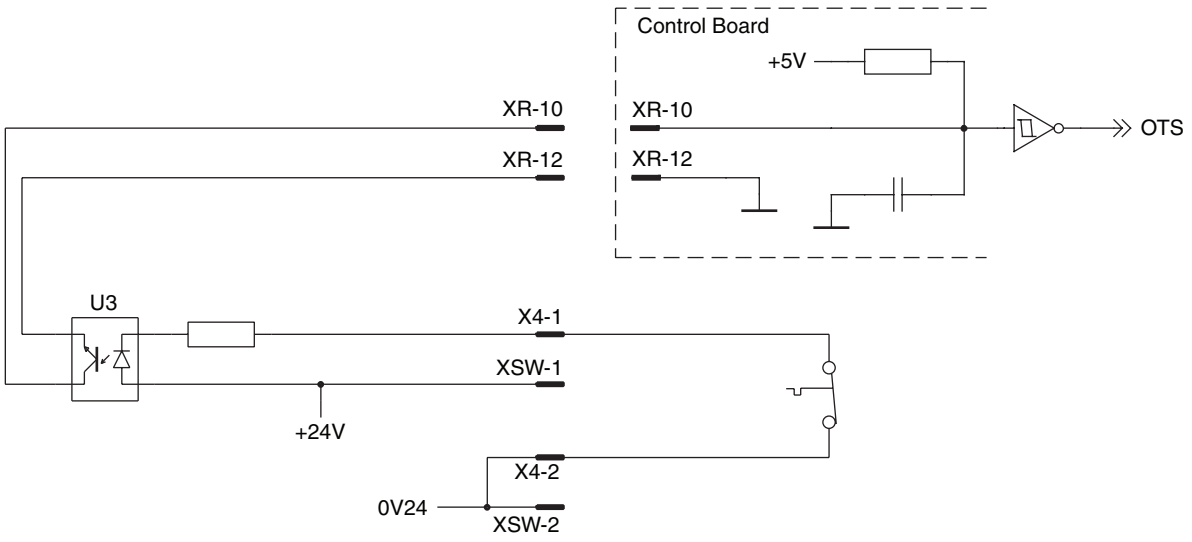
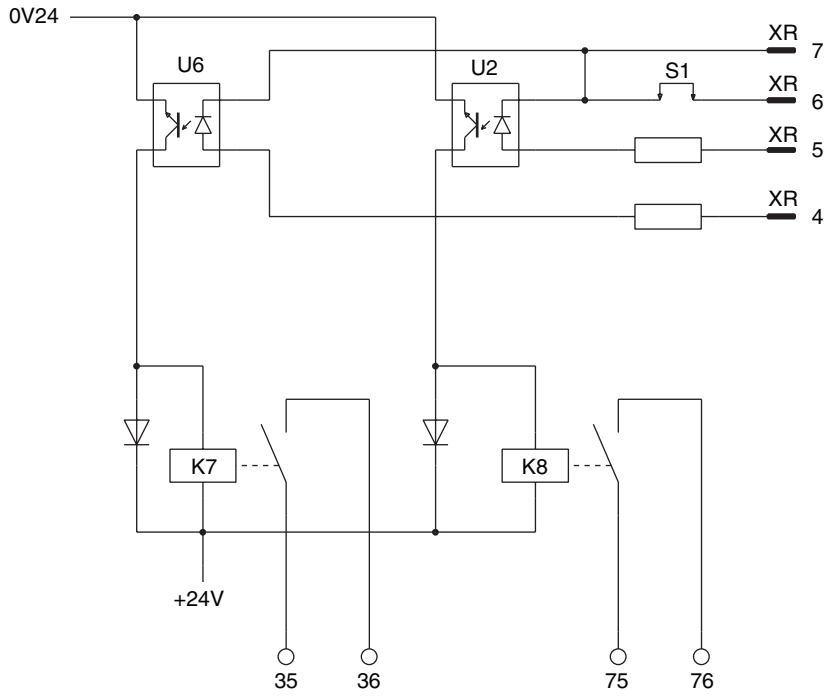


Figure 24 - Contactor Control Relays Control Circuit Diagram



Circuit Board Layouts and Connections

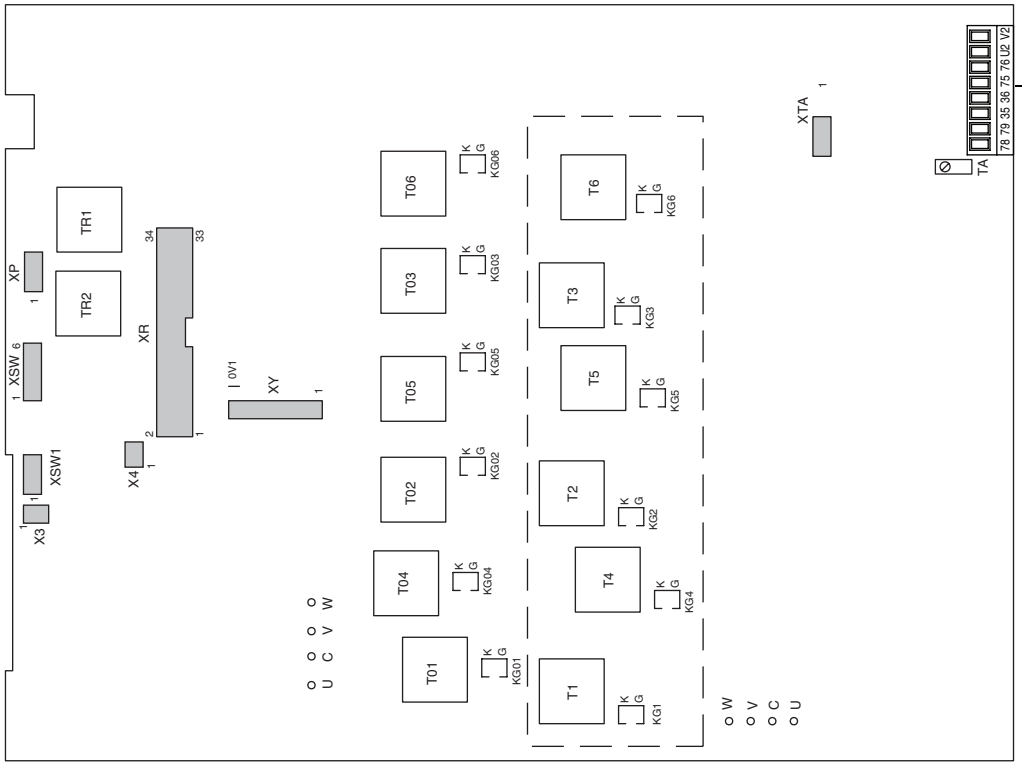
List of Circuit Board Layouts

The following images and tables detail the connection points for the frame A PowerFlex DC drive circuit boards and components.

Pulse Transformer Board

Figure 25 - Pulse Transformer Board Layout

Components shown within dashed lines are only on the pulse transformer board for regenerative drives.



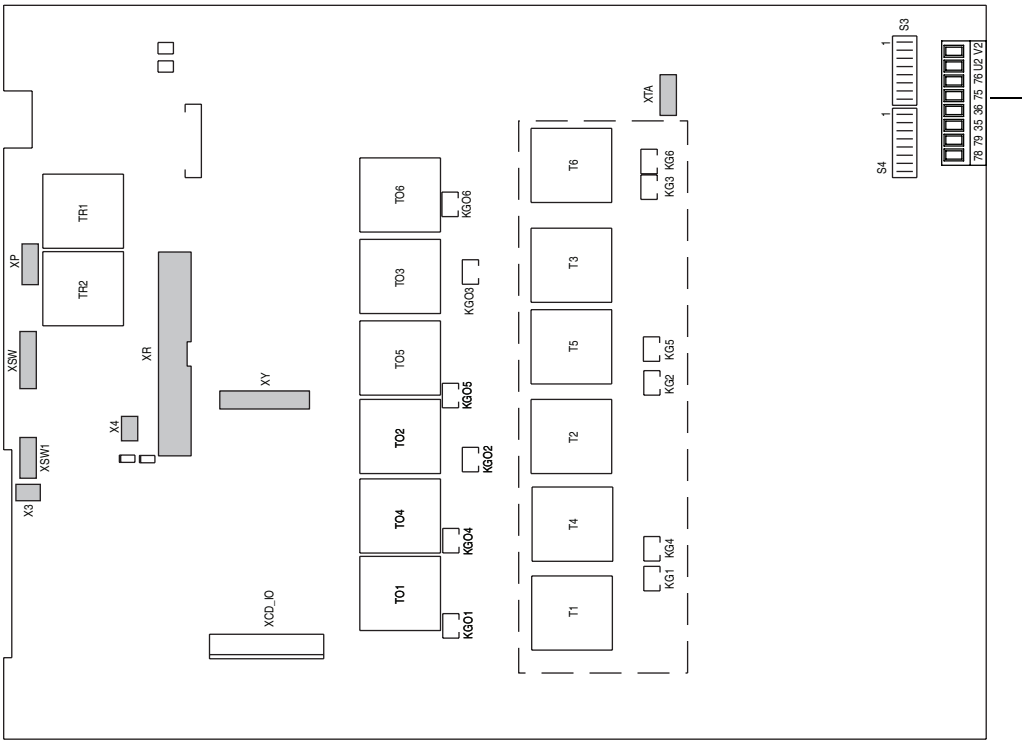


Table 18 - Pulse Transformer Board to Field Board Connections

Pulse Transformer Board Connector	Pin Number	to	Pin Number	Field Board Connector	Description
X3	1	…	1	X3	1U1 field sync signal (from U1)
	2	…	2		1V1field sync signal (from V1)

Table 19 - Pulse Transformer Board to Switching Power Supply Connections

Pulse Transformer Board Point	to	Pin Number	Switching Power Supply Board Connector	Description
1C2	…	4	XUV	Rectified U2-V2 voltage (approx. 150/300V DC)
	…	3		not used
1D2	…	2		not used
	…	1		Common

Table 20 - Pulse Transformer Board to Bimetal Thermostat Connections

Pulse Transformer Board Connector	Pin Number	to	Pin Number	Bimetal Thermostat Connector	Description
X4	1	…	1	X4	+24V supply through resistor
	2	…	2		24V common

Table 21 - Pulse Transformer Board to Field SCR/Dual Diode Module Connections

Pulse Transformer Board Connector	Pin Number	to	Pin Number	Field SCR/Dual Diode Module Connector	Description
XP	1	…	3	Fastons	Gate signal G1
	2	…	2		Common cathode (K1 and K2) for both field SCRs
	3	…	2		
	4	…	1		Gate signal G2

Table 22 - Pulse Transformer Board to Control Board Connections

Pulse Transformer Board Connector	Pin Number	to	Pin Number	Control Board Connector	Description
XR	1	…	1	XR	Gate signal G1 field SCR1
	2	…	2		Gate signal G2 field SCR2
	3	…	3		0V (GNDP)
	4	…	4		Relay output 35-36 command
	5	…	5		Relay output 75-76 command
	6	…	6		2Q/4Q selection signal
	7	…	7		0V (GNDP)
	8	…	8		I armature = 0 signal
	9	…	9		0V (GNDP)
	10	…	10		Heatsink overtemperature
	11	…	11		Digital U1-V1 sync signal
	12	…	12		0V (GNDP)
	13	…	13		CT burden signal
	14	…	14		0V (GND)
	15	…	15		Reduced U sync signal
	16	…	16		Reduced V sync signal
	17	…	17		Reduced W sync signal
	18	…	18		Reduced C (armature) signal
	19	…	19		Reduced D (armature) signal
	20	…	20		0V (GNDP)
	21	…	21		Gate signal SCR 4/01
	22	…	22		0V (GNDP)
	23	…	23		Gate signal SCR 5/02
	24	…	24		0V (GNDP)
	25	…	25		Gate signal SCR 6/03
	26	…	26		WH1 (not used, grounded)
	27	…	27		Gate signal SCR 1/04
	28	…	28		WL1 (not used, grounded)
	29	…	29		Gate signal SCR 2/05
	30	…	30		0V (GNDP)
	31	…	31		Gate signal SCR 3/06
	32	…	32		Motor overtemperature
	33	…	33		Enable reverse (MN) power bridge
	34	…	34		Enable forward (MP) power bridge

Table 23 - Pulse Transformer Board to Current Transducer Connections

Pulse Transformer Board Connector	Pin Number	to	Pin Number	Current Transducer	Description
XTA	1	...	Black	CT on Phase U	Secondary side CT phase U
	2	...	Brown		
	3	...	Black	CT on Phase V	Secondary side CT phase V
	4	...	Brown		

Switching Power Supply Board

Figure 26 - Switching Power Supply Board Layout

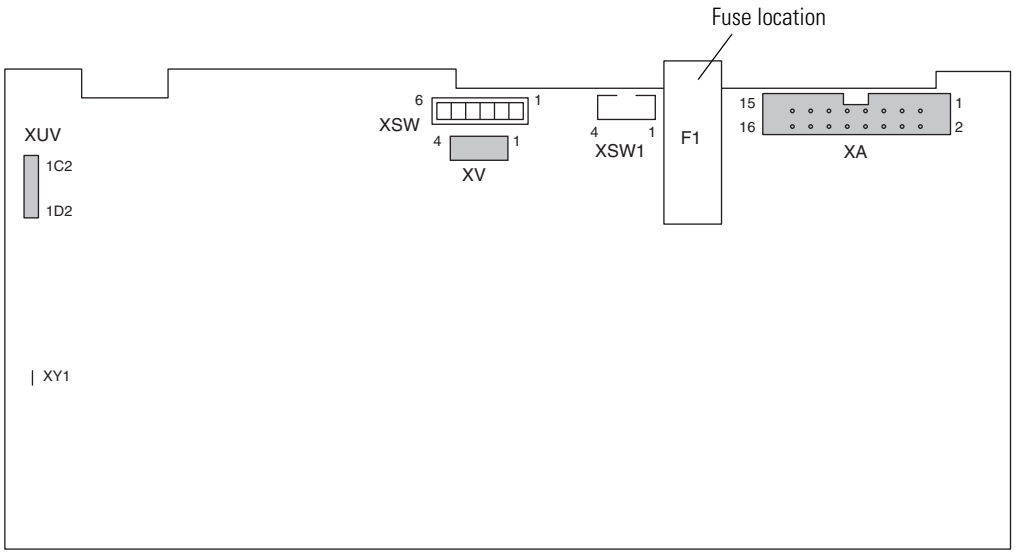


Table 24 - Switching Power Supply to Fan Connections

Control Board Connector	Pin Number	to	Pin Number	Fan Connector	Description
XV	1	...	1	XV	+24V
	2	...	2		
	3	...	3		24V supply common
	4	...	4		

Table 25 - Switching Power Supply Board to Control Board Connections

Switching Power Supply Board Connector	Pin Number	to	Pin Number	Control Board Connector	Description
XA	1	...	1	XA	+5V
	2	...	2		5V common
	3	...	3		+5V
	4	...	4		5V common
	5	...	5		+5V
	6	...	6		5V common
	7	...	7		SMPS supply input undervoltage
	8	...	8		
	9	...	9		+15V
	10	...	10		
	11	...	11		15V common
	12	...	12		
	13	...	13		-15V
	14	...	14		
	15	...	15		24V common
	16	...	16		+24V

See Pulse Transformer Board to Switching Power Supply Connections on page 121.

Control Board

Figure 27 - Control Board Layout

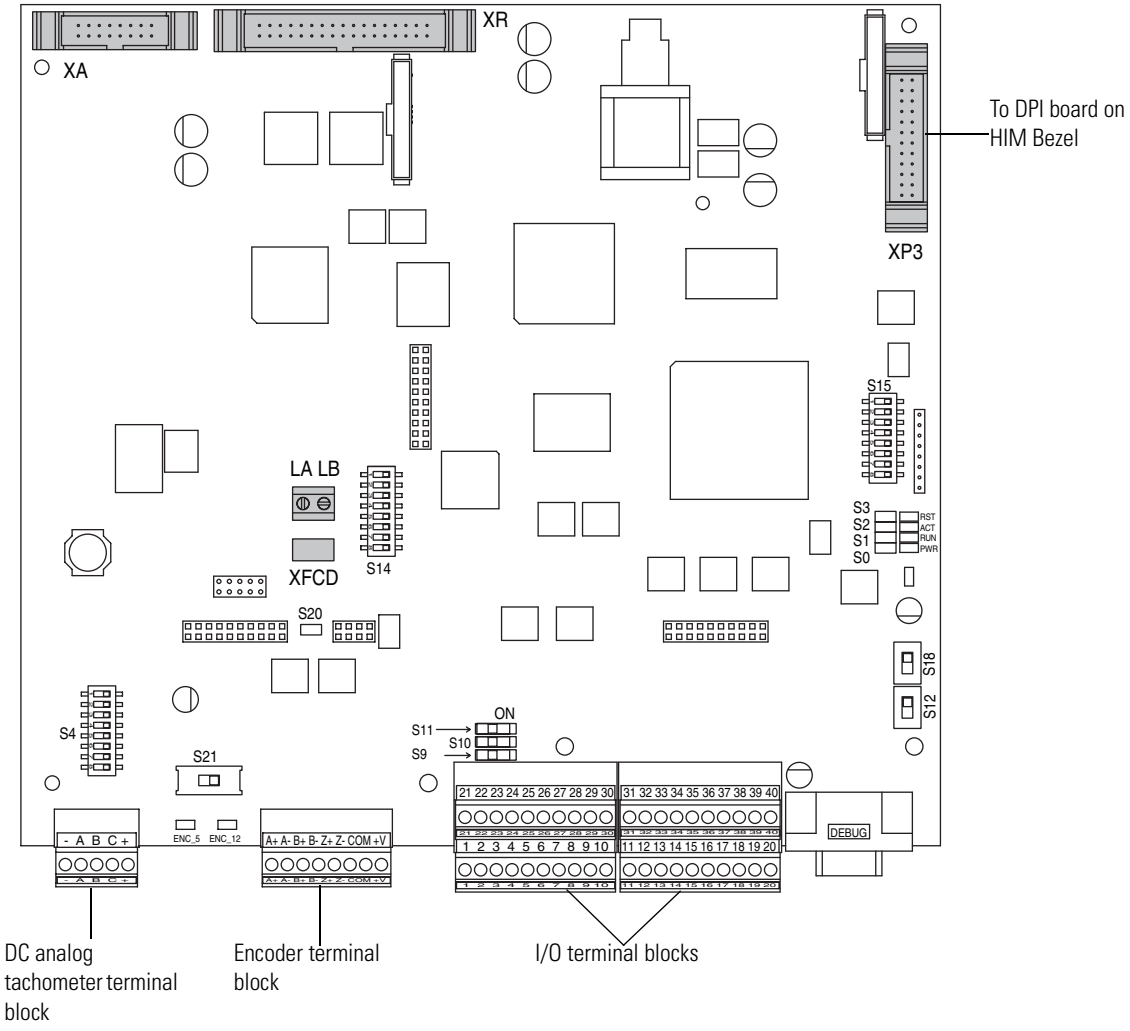


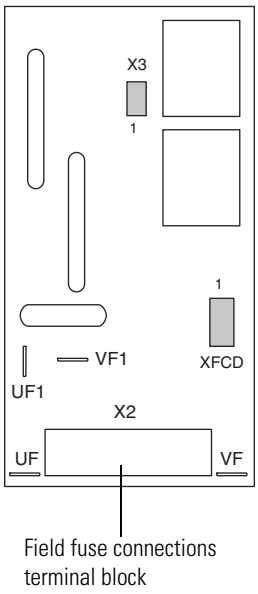
Table 26 - Control Board to Field Board Connections

Control Board Connector	Pin Number	to	Pin Number	Field Board Connector	Description
XFCD	1	...	1	XFCD	+15V
	2	...	2		15V Common
	3	...	3		-15V
	4	...	4		Field CT burden resistors

See Pulse Transformer Board to Control Board Connections on page 122 and Switching Power Supply Board to Control Board Connections on page 124.

Field Board

Figure 28 - Field Board Layout



See Control Board to Field Board Connections on page 125 and Pulse Transformer Board to Field Board Connections on page 121.

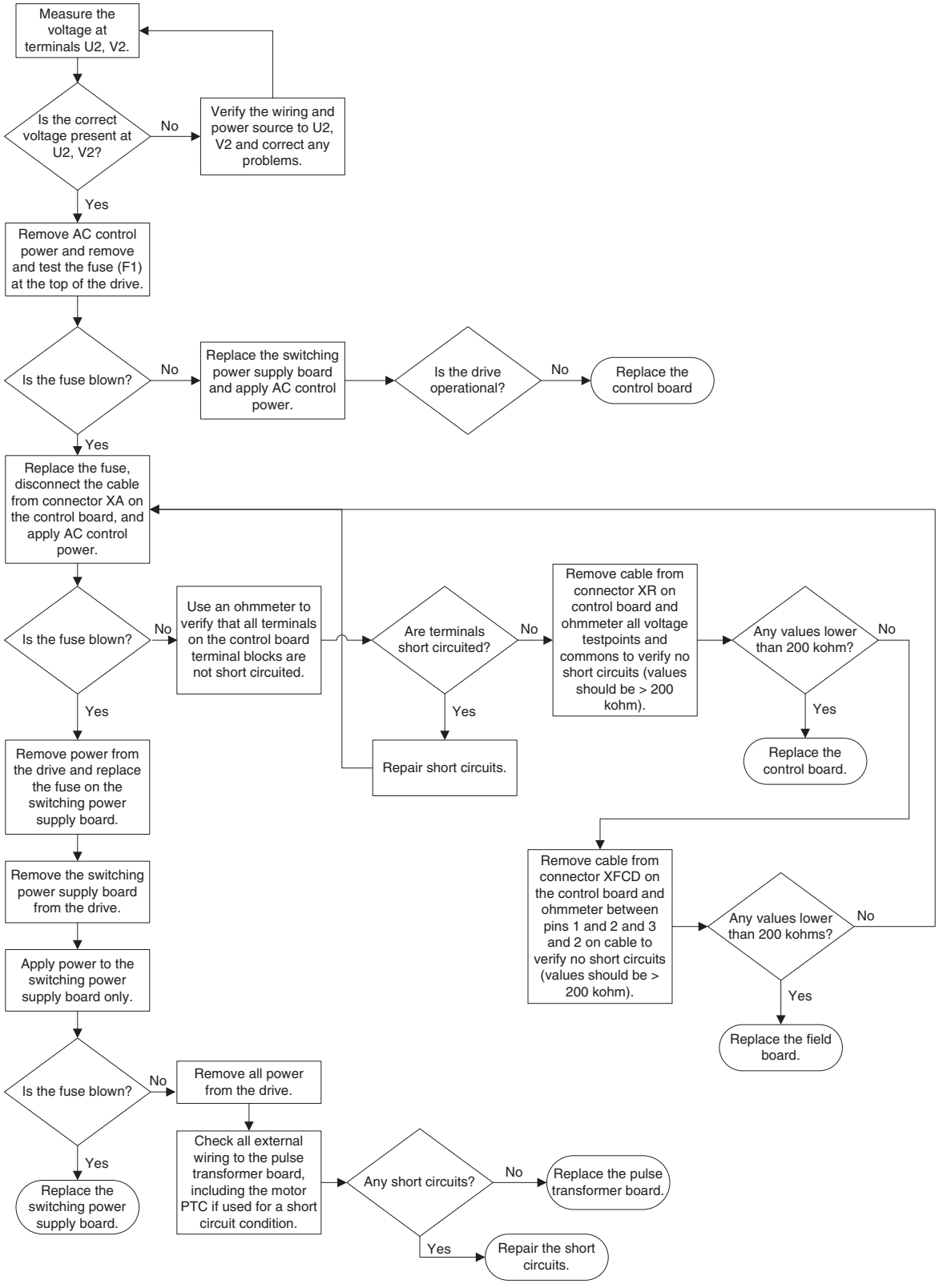
Flow Charts

List of Flow Charts

The following pages contain flow chart versions of troubleshooting procedures contained in Chapter 2 - Component Test Procedures.

Control Power Supply Failure

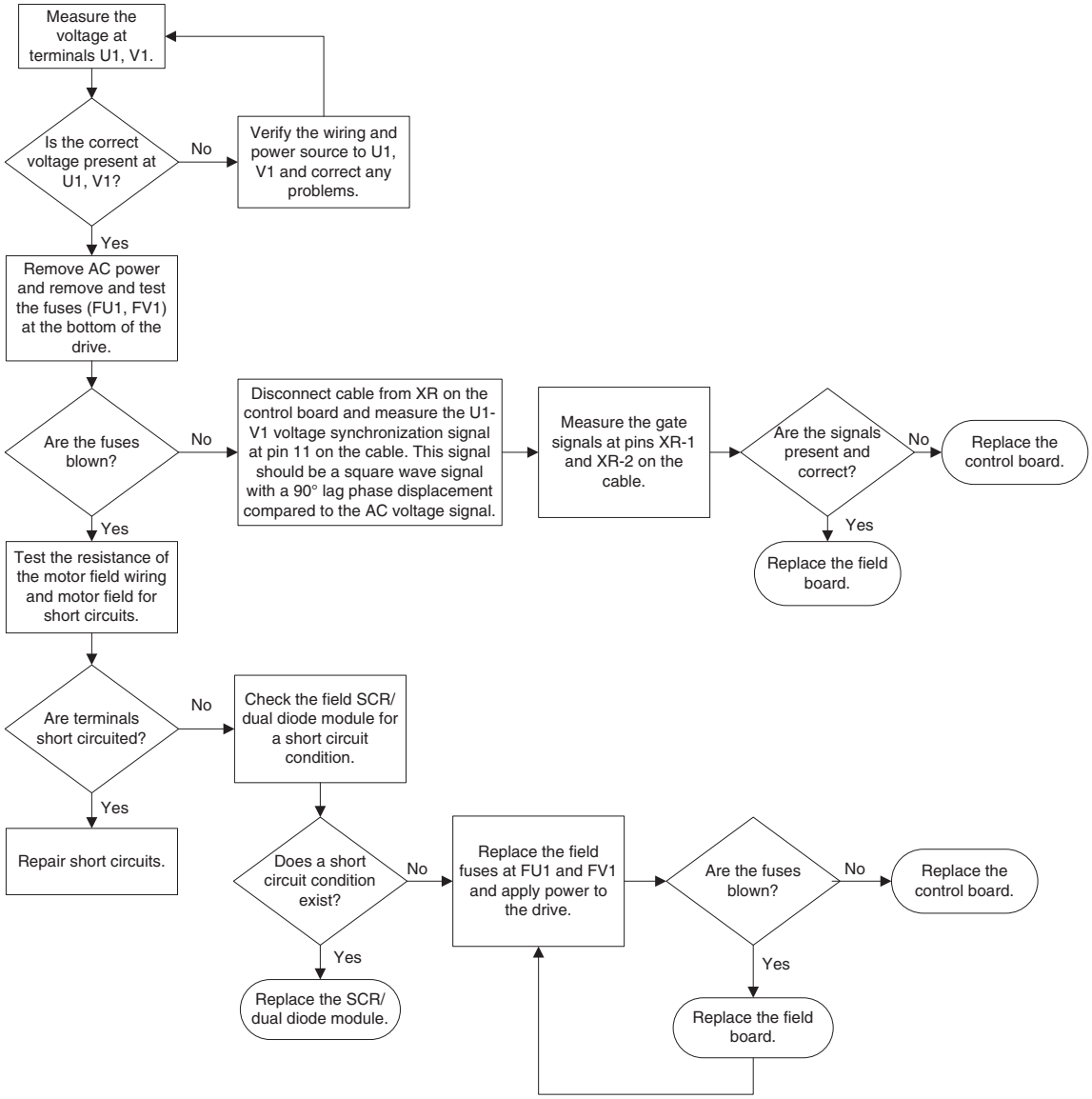
This chart presents the steps for troubleshooting a Power Failure fault (F3).



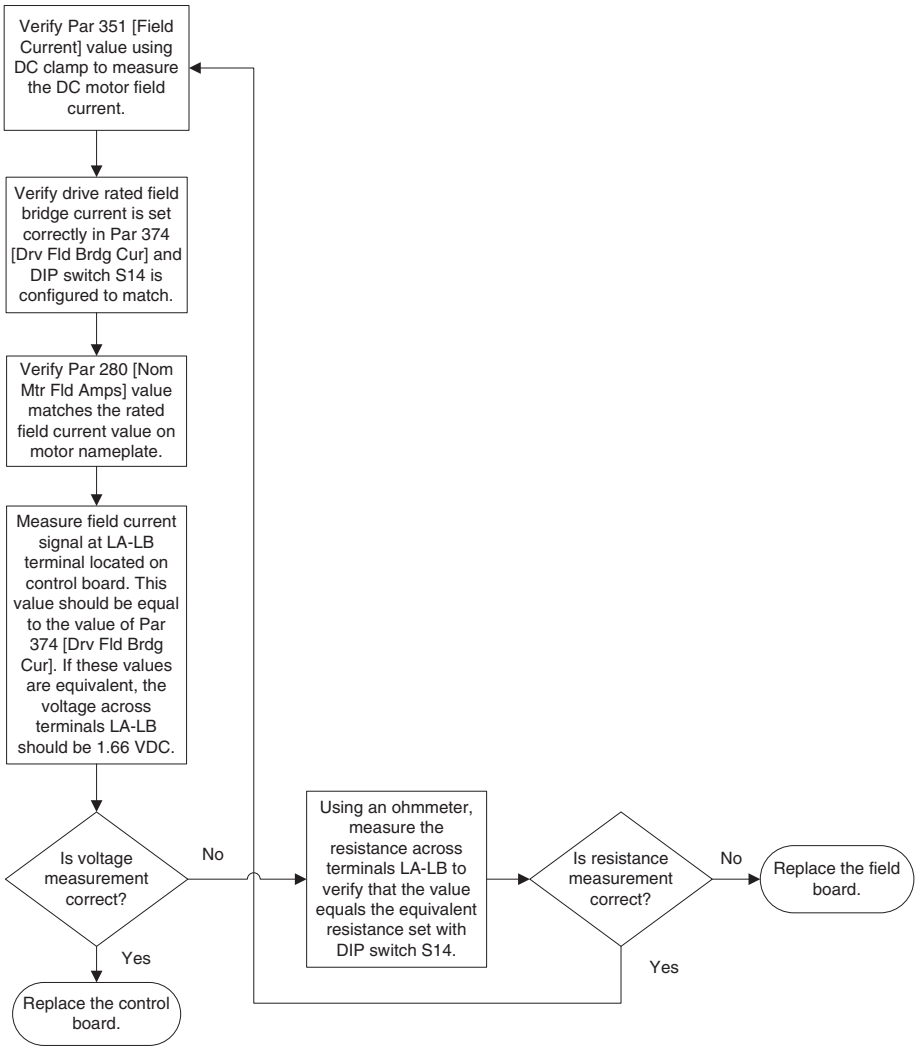
Field Current Loss Failure

The charts below presents the steps in flow chart form for troubleshooting a Field Current Loss fault (F6).

No Field Current



Low or Incorrect Field Current



Numerics

A

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V

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support/, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect[SM] support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

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If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

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Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

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